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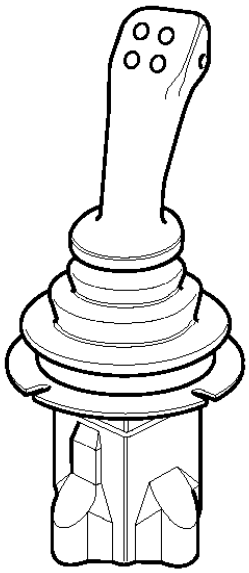
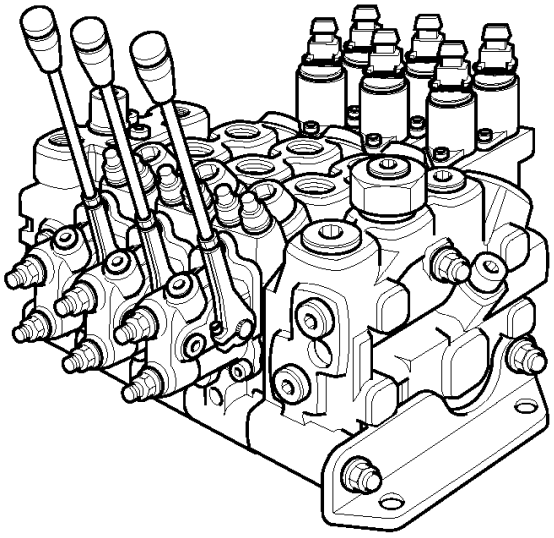
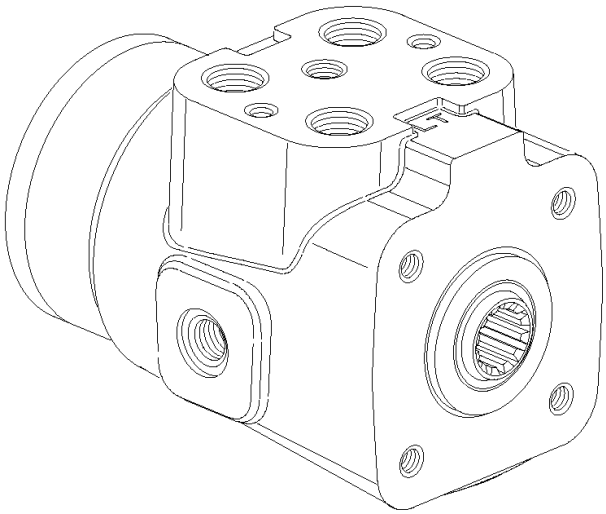






GENERAL

This section consists of service instructions and troubleshooting charts for serviceable components of the hydraulic system. Following this information are hydraulic schematics.

⚠WARNING!

Fluid escaping from a small hole can be almost invisible. Use a piece of cardboard or wood, rather than hands to search for suspected leaks.

⚠WARNING!

Fluid under pressure. Never attempt to disconnect any hydraulic lines unless boom and hydraulic operated components are secured, without possibility of movement in any direction. Relieve hydraulic system pressure by working control levers. A circuit may be completely depressurized by removing a pin from either rod end or base end of cylinder(s). High pressure fluid and falling components may cause injury or death.

⚠WARNING!

Escaping fluid under pressure can have sufficient force to penetrate the skin, causing serious personal injury. Before disconnecting lines, relieve all pressure. Before applying pressure to the system, be sure all connections are tight and that lines, pipes and hoses are not damaged.

HYDRAULIC OIL

The capacity of a hydraulic system to do work is a function of pressure and volume. Pressure is determined by resistance to flow and is normally limited by the relief valve setting. Inability to perform normal circuit functions due to insufficient pressure (below the setting of the relief valve) indicates excessive leakage, usually internal. In such an event, the leaking component should be repaired or replaced. Working pressures with a cold system may be somewhat higher than normal due to higher oil viscosity and greater mechanical friction. Fluctuating pressure may indicate dirty filters, pump cavitation , aerated oil, damaged pump or varying resistance.

The arrangement of this hydraulic system includes five separate circuits - boom lift, boom extension, fork tilt, sway, and steering.

The traversing machine hydraulic system includes a separate circuit for the traversing function.

The recommended hydraulic oil should have antiwear, antifoam, antirust and antioxidation properties for heavy duty use. The following hydraulic oil viscosity is recommended for use in this machine at all ambient temperatures.

RECOMMENDED ASTM VISCOSITY:
ISO VG 32

HYDRAULIC PRESSURE CHECKS AND ADJUSTMENTS

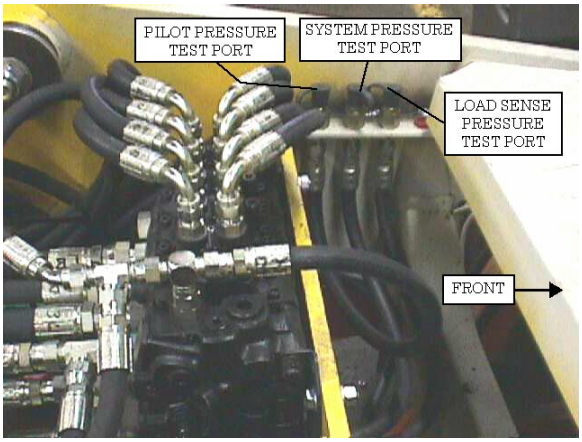
Occasionally, you should check the maximum operating pressures in the hydraulic system. There is no specified time interval as to when these pressures should be checked. Usually, pressure checks are made if the system is unable to perform normal hydraulic functions.

The maximum operating pressure for the hydraulic system is measured by operating any hydraulic function to its maximum stroke and holding it there while taking the gauge reading. This causes the hydraulic pump to provide maximum system pressure.

NOTE: ALL PRESSURES SHOULD BE TESTED WITH THE NORMAL OPERATING TEMPERATURE OF THE HYDRAULIC OIL FROM 80-120 °F (27-49 °C).

1. **To check hydraulic pilot pressure:**

    a. Locate pilot pressure diagnostic point on machine.



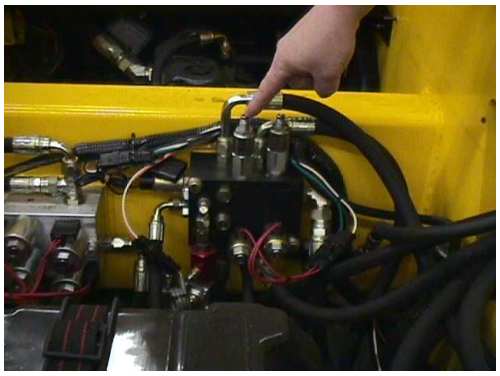
Pressure Checks, Valve in Front

Pressure Checks, Valve in Back

    a. With engine off, attach a 600 psi gauge to the pilot pressure diagnostic check point. Start engine and read gauge value while actuating a function.
    b. On units equipped with Dana axles/Clark transmission, pilot pressure should be 500 psi + or – 25 psi
    c. On units equipped with Carraro axles/transmission, pilot pressure should be 300 psi + or – 25 psi

2. **To adjust pilot pressure:**

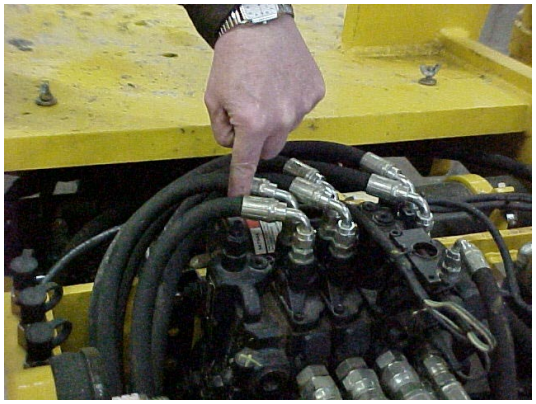
    a. Locate the brake manifold block. Loosen jam nut on pilot adjustment cartridge and turn counter clockwise 2 full turns. Start the machine and move the joystick function. Adjust pilot pressure to the desired pressure above. Tighten the jam nut and operate functions to insure correct pressure setting.



Brake manifold/Pilot adjust screw

3. Set Pressure Compensator on hydraulic pump:

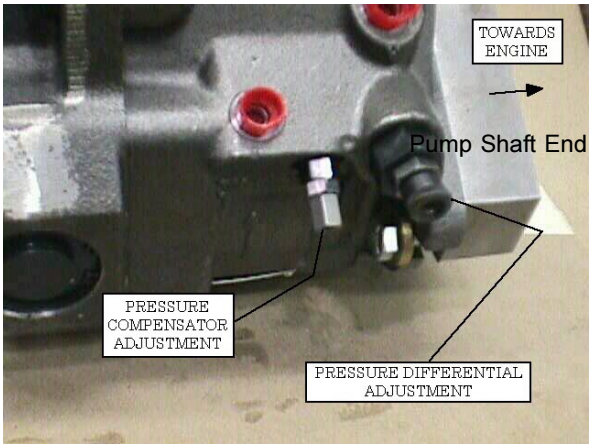
Locate the load sense relief adjustment on the main valve and turn the adjustment clockwise until it bottoms out. This sets the main load sense relief at its maximum setting.



Valve in Front Style Machines

Valve in Back Style Machines

a. Locate pressure compensator setting on the hydraulic pump. With a 5000 psi gauge on the **System Pressure** diagnostic point, retract the boom and hold the function in the retract mode to deadhead the system. Adjust the pressure compensator on the pump to 3450 psi + or – 25 psi. This adjustment is located on the lower quarter of the pump on the side closest to the operator compartment.



Pressure Compensator adjustment

a. Once the pressure compensator has been set, the load sense pressure relief on the main control valve must be adjusted

4. Set load sense pressure. The initial conditions for this procedure are with the engine running, and a 5000 psi gauge connected to the load sense pressure test port.

a. Locate the load sense pressure relief adjustment on the main control valve. With the engine running at approximately 2000 RPM, retract boom and deadhead the system by holding the joystick in the retract mode. Adjust the load sense relief adjustment on the valve to the following settings;

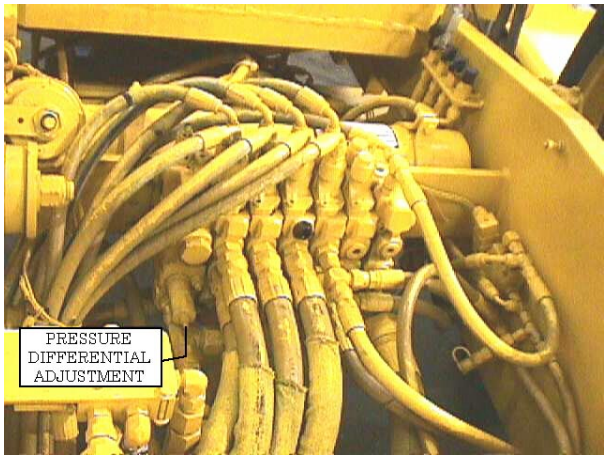
   i. On 6044/F-644, 10056/F-1056, and 10044/F-1044, load sense pressure should read 3250 psi + or – 25 psi.
   ii. On 6036/F-636, 8044/F-844, or 8036/F-836, load sense pressure should read 2800 psi + or – 25 psi.

5. Set Pressure Differential (Standby Pressure)

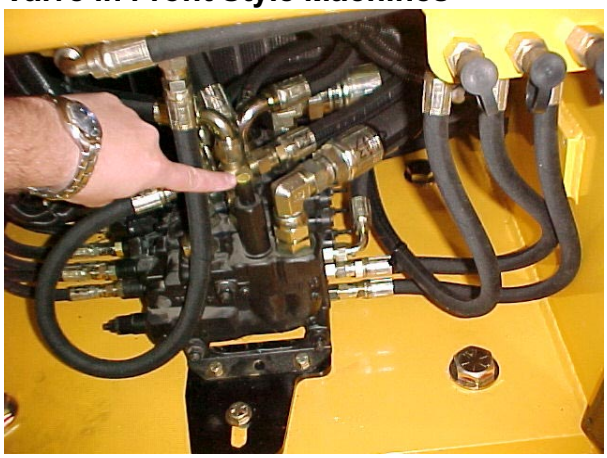
CAUTION! Do not run with the pump pressure differential setting higher than the main valve setting for more than 2-3 minutes! Pump overheating will occur!

Note: The following measurements are taken while the engine is idling and no hydraulic functions are being operated.

a. Locate pressure differential adjustment on main control valve. Bottom out the differential pressure adjustment on the main control valve by loosening the jam nut and turning the adjustment clockwise until it bottoms.
b. With the gauge on the System Pressure check point, Adjust the Differential Pressure adjustment on the pump to 625 psi initially, then adjust the Valve differential pressure to 600 psi. Finally, set the pump Differential Pressure back down to 500 psi. DO NOT TAKE MORE THAN 2-3 MINUTES TO MAKE THIS ADJUSTMENT!

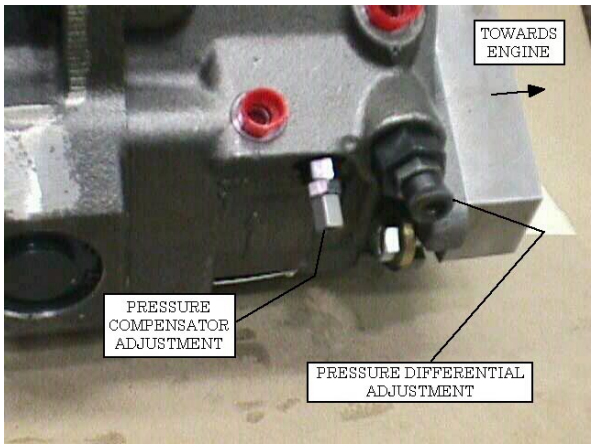


Valve in Front Style Machines



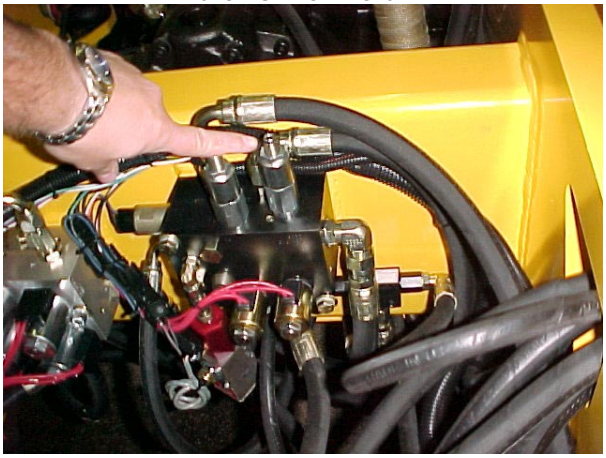
Valve in Back Style Machines

Differential Pressure Adjustment on Main Control Valve



Pump Differential Pressure Adjustment

6. **Set Steering Pressure:** These measurements must be taken with the gauge on the Load Sense diagnostic check point
    a. Locate Steering Pressure adjustment screw on the brake manifold.



Steering Pressure Adjustment

    a. With the engine running, bottom out steering by turning wheels all the way in one direction until it stops. Hold wheel in this position
    b. With gauge on the Load Sense diagnostic point, adjust the steering pressure adjustment screw on the brake manifold until steering pressure is set to 2500 psi + or – 25 psi.

1. **Final Checks:** Once the above procedure has been performed, verify that all adjustment screws on Pump, Main Valve, and Brake Manifold have been locked down with their associated jam nuts. Final pressure measurements as follows;

Machine Model	Pilot Pressure (psi)	System Pressure (psi)	Load Sense Pressure (psi)	Steering Pressure (psi)	Differential Pressure (Standby Pressure) (psi)
6036/F636	300	3450	2800	2500	500
6044/F-644 T-6044/T-644	300	3450	3250	2500	500
8036/F-836	300	3450	2800	2500	500
8044/F-844 T-8044/T-844	300	3450	2800	2500	500
10044/F-1044	300	3450	3250	2500	500
10056/F-1056	300	3450	3250	2500	500

Checking & Adding Hydraulic Oil

You should inspect the hydraulic oil level every 8 hours of operation or daily by observing the reservoir sight gauge. It is important to check the oil level daily to prevent air from entering the hydraulic system. If the oil level drops below the suction port, air can enter the pump causing cavitation (pump starvation). Return fluid entering the reservoir will also contain trapped air if it is discharged above the oil level.

CAUTION! TANK UNDER PRESSURE. REMOVE CAP SLOWLY.

USE CAUTION WHEN CHECKING HOT OIL!

Changing Hydraulic Oil

The hydraulic oil should be changed every 1,000 hours of operation or once per year. To drain the oil, follow these instructions:

1. Start engine and let hydraulic oil circulate through the system for several minutes. Circulating oil should remove any dirt particles which may have settled in the system.

2. Retract all hydraulic cylinders to force most of the oil back to the reservoir.

3. Shut down engine and place a suitable container under reservoir drain plug to catch the oil.

4. Remove drain plug to drain oil. Allow time for oil to drain from reservoir walls.

PROPERLY DISPOSE OF USED OIL. DO NOT POUR OIL ON THE GROUND, INTO SEWERS OR INTO BODIES OF WATER.

5. Remove the (8) capscrews and (8) lockwashers which secure the access cover to the reservoir. Remove cover.

6. Clean out sludge and sediment from bottom of reservoir. Clean tank magnet and replace on tank floor.

DO NOT FLUSH HYDRAULIC SYSTEM WITH KEROSENE OR ANY OTHER SOLVENTS.

7. Apply a thin layer of silicone gasket sealant to reservoir access cover. Install cover on reservoir and secure with the (8) capscrews and (8) lockwashers.

8. Apply thread sealant to drain plug and install.

9. Add hydraulic oil by pumping it from storage drum through a 10 micron filter into reservoir filler opening. Fill reservoir to “FULL” mark on sight gauge.

10. Prior to starting engine, the system must be bled of air. This is accomplished by removing the pump outlet hose and pushing air into hydraulic tank until oil exits pump pressure port. Connect hose and start unit.

11. Start engine and let engine idle. If there is no hydraulic pressure in 30 seconds, turn off engine and bleed air from the hydraulic system. Restart engine to check for hydraulic pressure. It is important that all functions be operated to ensure that new oil flows through all circuits.

12. Shut off engine. Add some more oil to maintain proper level. This is necessary to replace oil drawn into the system. DO NOT OVER FILL.

13. Inspect for leaks.

Hydraulic Oil Filters

The hydraulic oil is filtered by a main return line filters.

The main return line filters strain the oil returning to the reservoir from the main directional valve.

The hydraulic system depends on these filters to keep the oil clean. Filters which are not cleaned or replaced at recommended intervals can become plugged with debris and lose their ability to strain the oil.

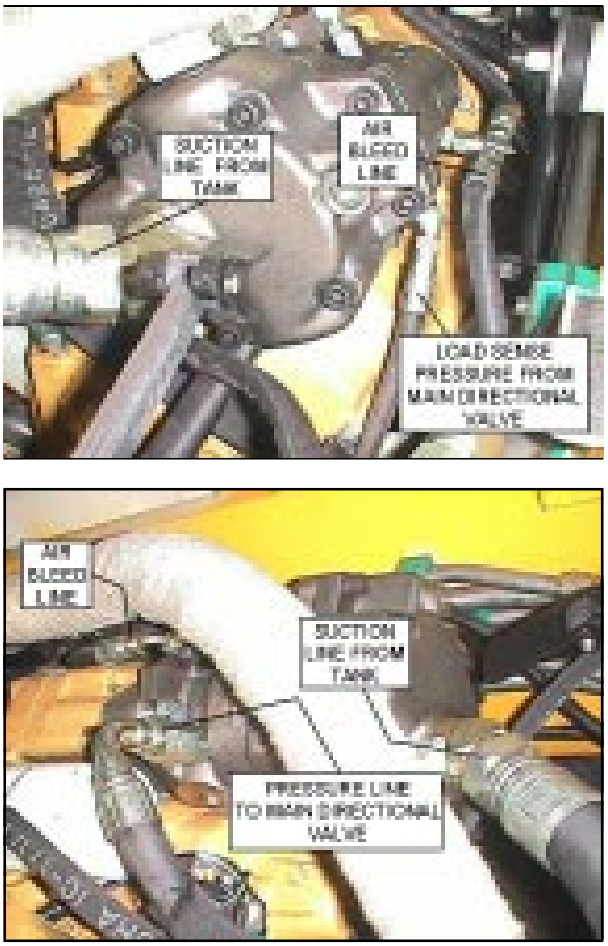
After the first 40 hours of operation, filters should be replaced. This is necessary since the oil may contain a high concentration of metal particles from initial wear of the new valves and cylinders. Refer to the owner's service guide to determine when the filters should be replaced.

In-Tank Return Filters

After the first 50 hours of operation, filters should be replaced. Refer to the owner's service guide to determine when the filters should be replaced.

Hydraulic Pump

Oil is circulated through the hydraulic system by a variable volume piston pump located on and driven by the torque converter. It contains seven pistons that ride along a swash plate. This swash plate, when adjusted, determines the stroke of the pistons which in turn determines the amount of flow. The swash plate is adjusted according to the amount of flow required from the pump, which is determined by the load on the hydraulics.


SUCTION LINE FROM TANK
AIR BLEED LINE
LOAD SENSE PRESSURE FROM MAIN DIRECTIONAL VALVE
AIR BLEED LINE
SUCTION LINE FROM TANK
PRESSURE LINE TO MAIN DIRECTIONAL VALVE

Hydraulic Pump Lines

Pump Cavitation

Cavitation occurs when an insufficient supply of oil reaches the pump suction chamber. Since the pump does not receive enough oil, it begins sucking in air instead. This condition is indicated by a high noise level in the pump.

IF THE PUMP EMITS A HIGH-PITCHED NOISE, SHUT OFF ENGINE IMMEDIATELY. CONTINUED OPERATION OF A CAVITATING PUMP WILL CAUSE SEVERE DAMAGE TO ITS WORKING PARTS.

To prevent cavitation:

1. Keep hydraulic oil level up to 'FULL' mark on reservoir dipstick.
2. Allow oil to warm up in cold weather.
3. Keep suction line free of obstructions.

Removal of Pump

Should you find it necessary to service the hydraulic pump during its life expectancy, you will see a noticeable drop in performance occur. It is advisable to make an inspection and replace parts or components which may have become worn. Expendable parts such as o-rings, seals, washers and gaskets should never be reused even though inspection may show these items as being serviceable. Alternately, the complete unit may be replaced.

> ⚠ WARNING!
>
> Heavy components! Before removing the pump, check its weight and make provisions for attaching and lifting. Use a hoist capable of supporting the weight. A slipping or falling component may result in injury or death to personnel.

1. Thoroughly clean the pump and hydraulic connections with a cleaning solvent.

2. Match-mark the hydraulic lines and pump ports to ensure correct connections during installation.

3. Disconnect hydraulic lines from pump. Cap the lines and pump ports to prevent contamination.

4. Attach a suitable lifting strap from hoist to pump.

5. Remove the (2) capscrews and (2) lockwashers which secure the pump to the torque converter. Lift pump from machine.

Pump Service Information

For complete pump service information, refer to the service guide included at the end of this manual.

Installation of Pump

> ⚠ WARNING
>
> Heavy components! Before installing the pump, check its weight and make provisions for attaching and lifting. Use a hoist capable of supporting the weight. A slipping or falling component may result in injury or death to personnel.

1. Secure a suitable lifting strap from hoist to pump. Lift the pump into position on torque converter.

2. Install a new gasket between the torque converter and the pump. Hold the gasket in place with a light coating of grease.

3. Insert pump driveshaft into torque converter drive, being certain to properly engage splines. Secure pump to converter with the (2) capscrews and (2) lockwashers. Remove lifting strap.

4. Fill pump ports with clean hydraulic oil to provide initial lubrication.

5. Connect hydraulic lines to pump and bleed air from system.

6. Start engine. Prime the pump by letting the engine idle with no load applied to the hydraulic system for at least two minutes. Inspect pump for leaks.

HYDRAULIC PUMP TROUBLESHOOTING CHART AND SERVICE REPAIR

The following chart lists the common difficulties experienced with the hydraulic pumps. It also indicates the probable causes and remedies for each of the troubles listed. This chart is organized to cover trouble that may occur due to improper service and maintenance. It should always be remembered that many apparent pump failures are actually the failures of other parts of the systems. The causes of improper operation are best diagnosed with adequate testing equipment and a thorough understanding of the complete hydraulic system.

Please refer to your Parts Manual for pump parts breakdown.

HYDRAULIC PUMP TROUBLESHOOTING

SYMPTOM	PROBABLE CAUSE	REMEDY
Pump not delivering oil	Pump driveshaft coupling sheared (direct drive).	Remove pump and determine damage. Replace defective parts.
	Oil suction port in reservoir blocked.	Remove contamination and flush suction line with clean hydraulic oil. Check sump strainer for dirt and sludge.
	Oil viscosity too heavy to pick up prime.	Drain system and replace with new oil of correct viscosity (ASTM ISO VG 32).
	Air leaks on suction line, pump not priming.	(1) Inspect suction line for leaks by pouring oil over fittings. Tighten loose connections. (2) Check reservoir oil level. The oil level must be above the suction port. (3) Check minimum speed of pump driveshaft which may be too slow to prime the pump.

Hydraulic Pump Troubleshooting

SYMPTOM	PROBABLE CAUSE	REMEDY
Pump makes excessive noise	Partially blocked suction line.	Remove contamination and flush suction line with clean hydraulic oil. Check for loose lining in suction hose.
	Low oil level in reservoir.	Add oil to 'FULL' mark on sight gauge.
	Air leak at pump suction hose joint or pump shaft seal.	Pour oil over fittings and around driveshaft to check for air leaks. Replace defective pump seal.
	Collapsed suction hose.	Test at full rpm as hose may be normal at low speed, but collapses at high speed.Replace as necessary.
Pump never stops pumping, oil is excessively hot, or main directional valve makes excessive noise.	Improper DP setting between pump and main directional valve	Adjust DP pressure setting using the pressure adjustment procedures.

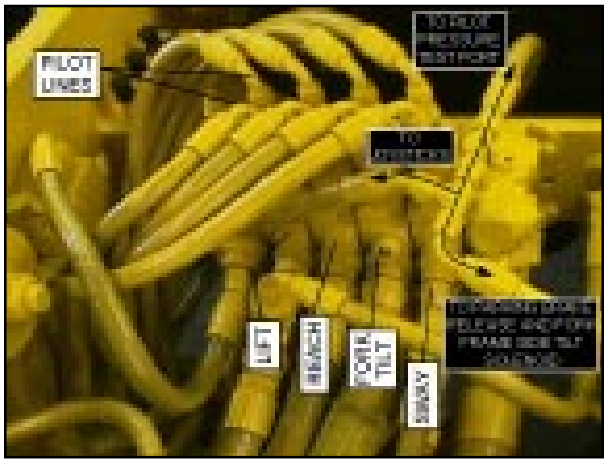
Remote-Controlled Main Directional Valve

This machine is equipped with an L90LS closed-center proportional load sensing and pressure compensated system valve.

Oil from the pump enters the directional valve through the inlet port located on the far left section, as shown. Oil returns to the reservoir through the outlet port located on the section that is on the opposite side of the valve, as shown, also.

Main Directional Valve - No Plumbing

Main Directional Valve - Installed



FRONT OF MACHINE

All of the boom functions are pilot controlled at the main directional valve.

REAR OF MACHINE

The LS, PX, PL, and LSP functions are shown below:

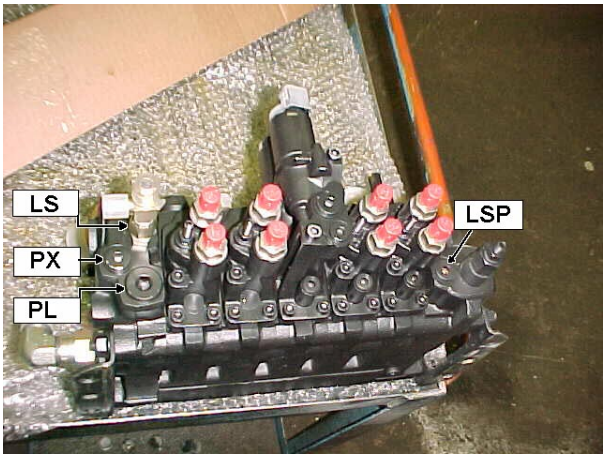
LS - This is the Load Sense Pressure line that sends the load signal back to the hydraulic pump.

PX - This line sends oil to the system pressure test port

PL - This line sends oil to the load sense pressure test port.

LSP - This line carries load sense pressure returning from the brake/steering systems.

P2B - This line sends oil to the brake charge manifold.



REMOVAL OF MAIN VALVE

> ⚠ WARNING!
>
> Heavy components! Before removing the valve, check its weight and make provisions for attaching and lifting. Use a hoist capable of supporting the weight. A slipping or falling component may result in injury or death to personnel.

1. Disconnect battery ground cable.

2. Remove the access cover.

3. Thoroughly clean the valve and hydraulic connections with a cleaning solvent.

4. Match-mark hydraulic lines and valve ports to ensure correct connections during installation.

5. Disconnect all hydraulic lines from the valve bank and ensure that there is a container to catch any oil that will spill. Cap the lines and valve ports to prevent contamination.

6. Match-mark the electrical plugs and solenoids to ensure correct connections during installation.

7. Secure a suitable lifting strap from hoist to valve.

8. Remove the (4) capscrews, (4) lockwashers and (4) nuts which secure the valve to the mount. Lift valve from machine.

INSTALLATION OF MAIN VALVE

1. Install the valve onto the mount and secure with the (4) capscrews, (4) lockwashers and (4) nuts. Remove lifting strap.

2. Connect hydraulic lines, electrical plugs and solenoids to valve.

3. Connect ground cable to battery.

4. Start engine and actuate all valve functions to ensure correct operation. Inspect valve for leaks.

5. Install access cover.

Main Directional Valve Troubleshooting

SYMPTOM	PROBABLE CAUSE	REMEDY
Oil leaks at either end of spool	Defective o-ring(s) in spool control.	Replace o-ring(s).
Oil leaks between sections	Pinched or blown seal(s).	Replace seal(s).
	Tie rod fasteners not correctly torqued.	Torque fasteners to 44 ft. lbs.(60 Nm).
Spool does not return to neutral position	Broken centering spring(s) in spool control.	Replace spring(s).
	Bent spool.	Replace section.
	Foreign particles in valve.	Clean valve.
Solenoid for fork frame side tilt fails to energize	Defective fuse, switch or solenoid.	Ensure that 12 vdc is available to solenoid coil. If no voltage available, replace fuse or switch. If voltage is available, replace solenoid.
	Defective electrical wire from switch to solenoid.	Repair wiring defects or replace wiring.
	Electrical plug disconnected from solenoid.	Connect plug to solenoid.
No motion, slow or jerky action of hydraulic system	Low oil level in reservoir.	Add oil to 'FULL' mark on sight gauge.
	Valve body cracked inside.	Replace valve section.
	Spool not moved to full stroke.	Check spool travel.
Main valve makes excessive noise, oil excessively hot, or pump does not stop pumping	Improper DP setting between pump and valve.	Adjust accroding to procedure of main valve and pump.
Load drops when spool moved to a working position	Load larger than capacity.	Reduce to rated load capacity at rated load center.

(HRC) Hydraulic Remote Control Valve (Joystick)

The remote control (joystick) valves supply pressure to the main directional valve. This pilot pressure shifts the main valve spools which direct oil to the cylinders.

The remote control valves are mounted in front of the arm rest, in the operator's compartment.

Removal of Remote Control Valves

1. Disconnect the battery ground (-) cable.

2. Remove the console cover by taking off the two wing nuts that hold on the arm rest and lift the cover off.

3. Thoroughly clean the valves and hydraulic connections with an approved cleaning solvent.

4. Match-mark the hydraulic lines and valve ports to ensure correct connections during installation.

5. Disconnect hydraulic lines from joystick. Cap the lines and valve ports to prevent contamination.

6. Disconnect the joystick electrical wire underneath the mounting bracket.

7. Remove the four (4) socket head fasteners on each of the joysticks, and remove the joysticks.

Joystick s

MOUNTING BRACKET CAPSCREWS

INSTALLATION OF REMOTE CONTROL VALVE

1. Install the valves onto the mounting bracket with the four (4) socket head fasteners for each joystick.

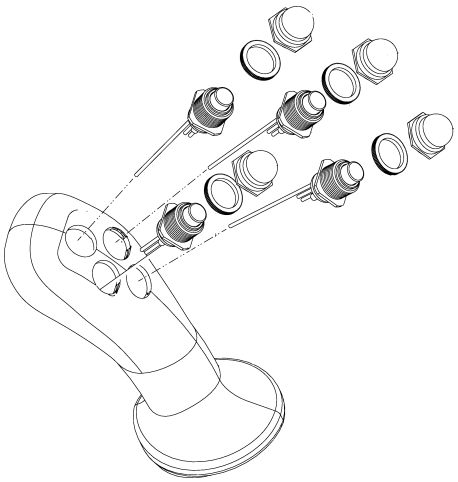
2. Connect the joystick wires to the terminal.

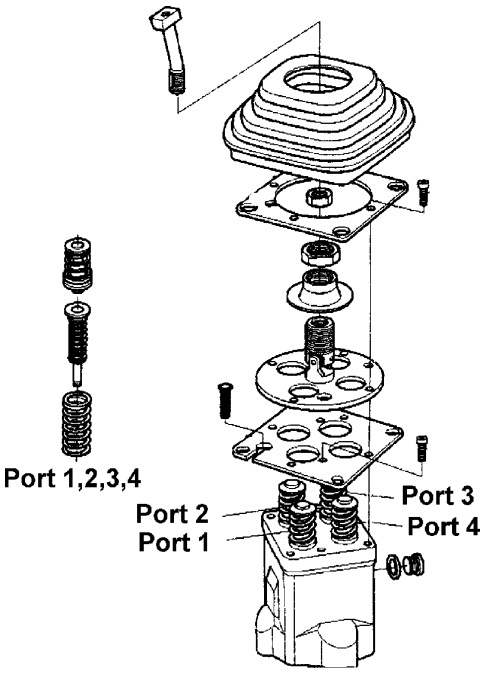
3. Connect the hydraulic lines to the valves.

4. Connect the ground (-) cable to the battery.

5. Start engine and actuate joystick to ensure correct operation. Be sure to check forl eaks as the joysticks are operated.

6. Replace console cover and armrest with the two wing nuts.





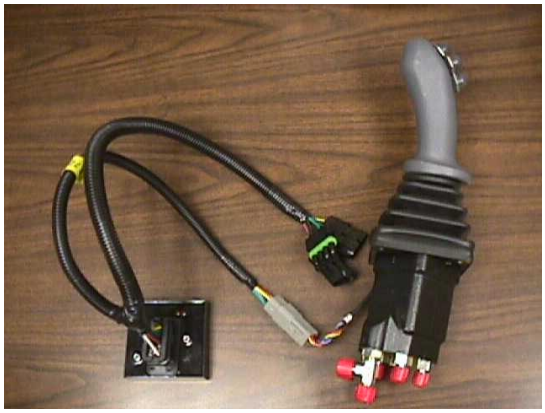
REMOTE CONTROL (JOYSTICK) TROUBLESHOOTING

SYMPTOM	PROBABLE CAUSE	REMEDY
Pilot-operated spools in main valve do not shift when joystick is actuated	Improper stand-by pressure.	Adjust the pressure compensator.
	Not enough pilot pressure supplied to main valve.	Pilot pressure should be within the range of 300 psi (±25 psi). If it is not, clean filter and clean or replace pilot spool.
	Leak(s) in pilot lines from remote control valve.	Tighten pilot hose couplings or replace defective hoses.
	Blocked pilot lines.	Remove contamination and flush pilot lines with clean hydraulic oil.
Joystick chatters	Pilot pressure too high.	Check pilot pressure using a 600 psi pressure gauge. Correct pressure should be within the range of 300 psi (±25 psi). If pressure is too high, clean or replace pilot spool in main directional valve.
Wrong response to joystick movement	Pilot lines connected to wrong valve ports.	Reconnect lines to correct ports.
Joystick does not center	Broken centering springs.	Replace springs.
0il leaks between sections of remote control valve	Defective section o-ring.	Replace o-ring.

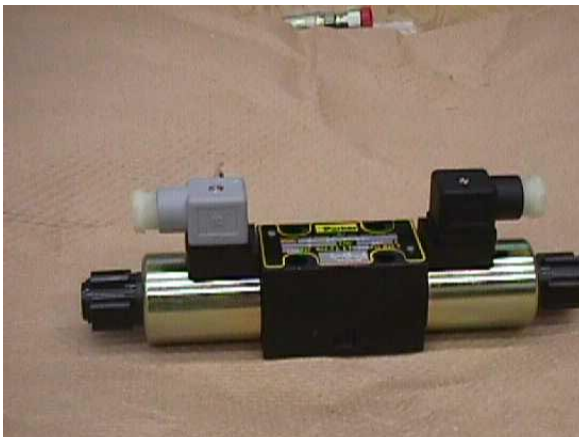
Fork Tilt and Auxiliary Hydraulic Joystick with 2 Axis Drive Card

Overview

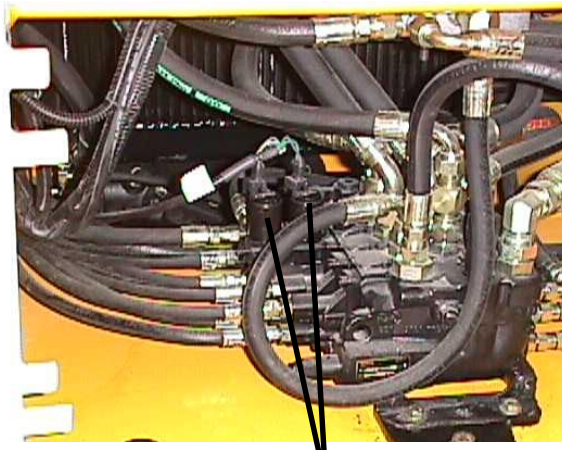
The Fork Control; Consist of four control buttons mounted in the joystick handle, the 2 axis driver module, the solenoid operated fork-up down section of the main valve, the auxiliary fork rotate solenoid operated valve, the auxiliary charge relay and the charge solenoid valve on the brake charge manifold.



Fork Tilt and Auxiliary Function Joystick with Digital PWM Module



Proportional D1VW Solenoid Valve

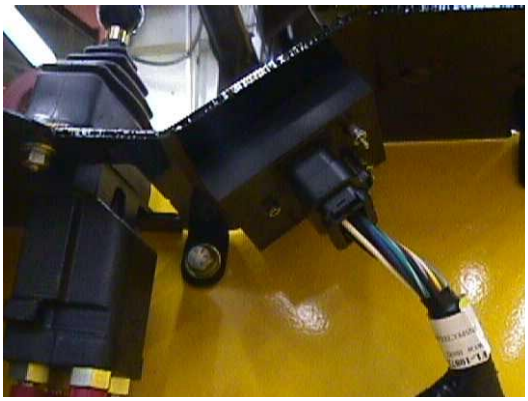


L90 Tilt Section Solenoids

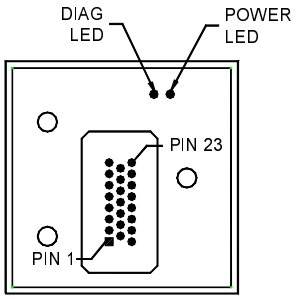
1. The fork up and down buttons supply an analog voltage reference to the 2 axis driver proportional to button depression, varying approximately .5 VDC to 4.2 VDC, to control the speed of operation.

Digital PWM Module

2. The 2 Axis driver is located under the arm-rest bracket, underneath the fiberglass console on the RH side of the operator compartment.



3. The 2 axis driver is a Pulse Width Modulated (PWM), current compensated output control which maintains a constant level of current to the solenoid coils, proportional to an input signal from the joystick ensuring constant hydraulic operation regardless of system temperature and voltage variations. The driver is equipped with two monitor Leds; power and diagnostic.



The power LED lights whenever power is applied to the unit by the key switch.

The diagnostic LED indicates an input circuit failure, and should not be lit during normal operation. An open circuit in any of the input circuits from the joystick, fork up or down and fork rotate cw or ccw will cause the LED to light and the driver to lock out ALL output functions; therefore, and input failure in fork-up-down will also lock out fork cw-ccw operation, and vice versa.

The diagnostic LED can be tested by disconnecting the connector from the grip assembly to the controller harness which will turn the LED on.

Operation

1. With no buttons pressed, there should be no voltage at pins 11 and 12.

2. With a button pressed, depending on the axis, Vbatt minus of about 1 volt will be present at either pin 11 or 12.

3. Normal standby reference voltage of the four control input may range from .5 vdc to 1.2 vdc approximately.

4. Depressing any control button causes its reference voltage to begin rising. At l.4 vdc the driver control threshold is reached, which switches the output of that function on, supplying voltage to the appropriated control solenoid coil, and regulating the control current to it at minimum value.

5. At this point, the driver locks out the opposite motion output, regardless of its input level. If fork up has reached threshold, fully depressing fork down will have no effect until fork up input is reduced below threshold voltage. This prevents the control valves from attempting to operate in both directions at one time.

6. Further depressing the control button varies the input voltage to maximum, and the driver increases the control current proportionally to maximum, allowing smooth speed increase (decrease by releasing the control button) of the controlled function. The driver reaches maximum voltage output of approximately 3.6 VDC.

7. Maximum current values for the control Solenoids Are;

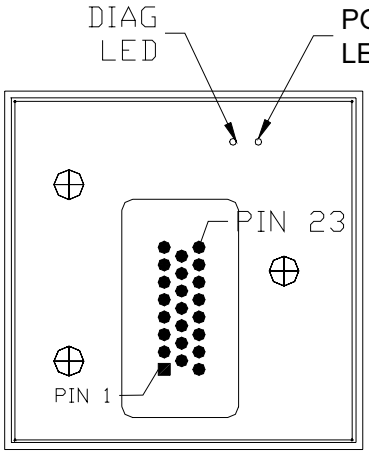
Fork up, Fork down 1.0A
Fork cw, Fork ccw 1.75A prior to 8/1/00
2.0 A after 8/1/00

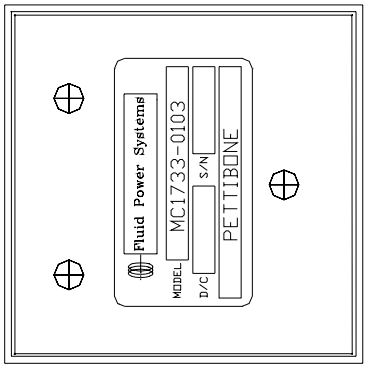
NOTE 1: THAT MAXIMUM JOYSTICK REFERENCE VOLTAGE OF 4.2 VDC IS ABOVE THE 3.6 V INPUT NECESSARY FOR MAXIMUM DRIVER CURRENT OUTPUT. THIS ASSURES FULL SOLENOID SHIFT FOR MAXIMUM SPEED.

NOTE 2: THE DRIVER ALSO CONTROLS PUMP LOAD SENSING FOR THE FORK ROTATE FUNCTION, BY ENERGIZING THE AUXILIARY LOAD SENSE RELAY COIL. THE RELAY CONTACTS THEN OPENS, DE-ENERGIZING THE CHARGE VALVE SOLENOID COIL, ALLOWING THE PUMP TO SENSE THE FORK ROTATE VALVE OPERATION.

Digital PWM Module Specifications

SPECIFICATIONS:
4KBYTES OF IN-CIRCUIT PROGRAMMABLE FLASH
INPUTS: 4 - ANALOG (0-5VDC)
OUTPUTS: 4 - 2AMP CURRENT COMPENSATED PROPORTIONAL
2 - 2AMP ON/OFF
(2 AXIS DRIVER)
POWER INPUT: 10 - 30VDC
TEMP: -20C TO 70C
CONNECTOR: AMPSEAL PLUG 770680-1
AMPSEAL SOCKET PIN 770854-1
ENVIRONMENTAL RATING TO AMP SPEC 109-74-5
WHICH IS AN IP66 EQUIVALENT.

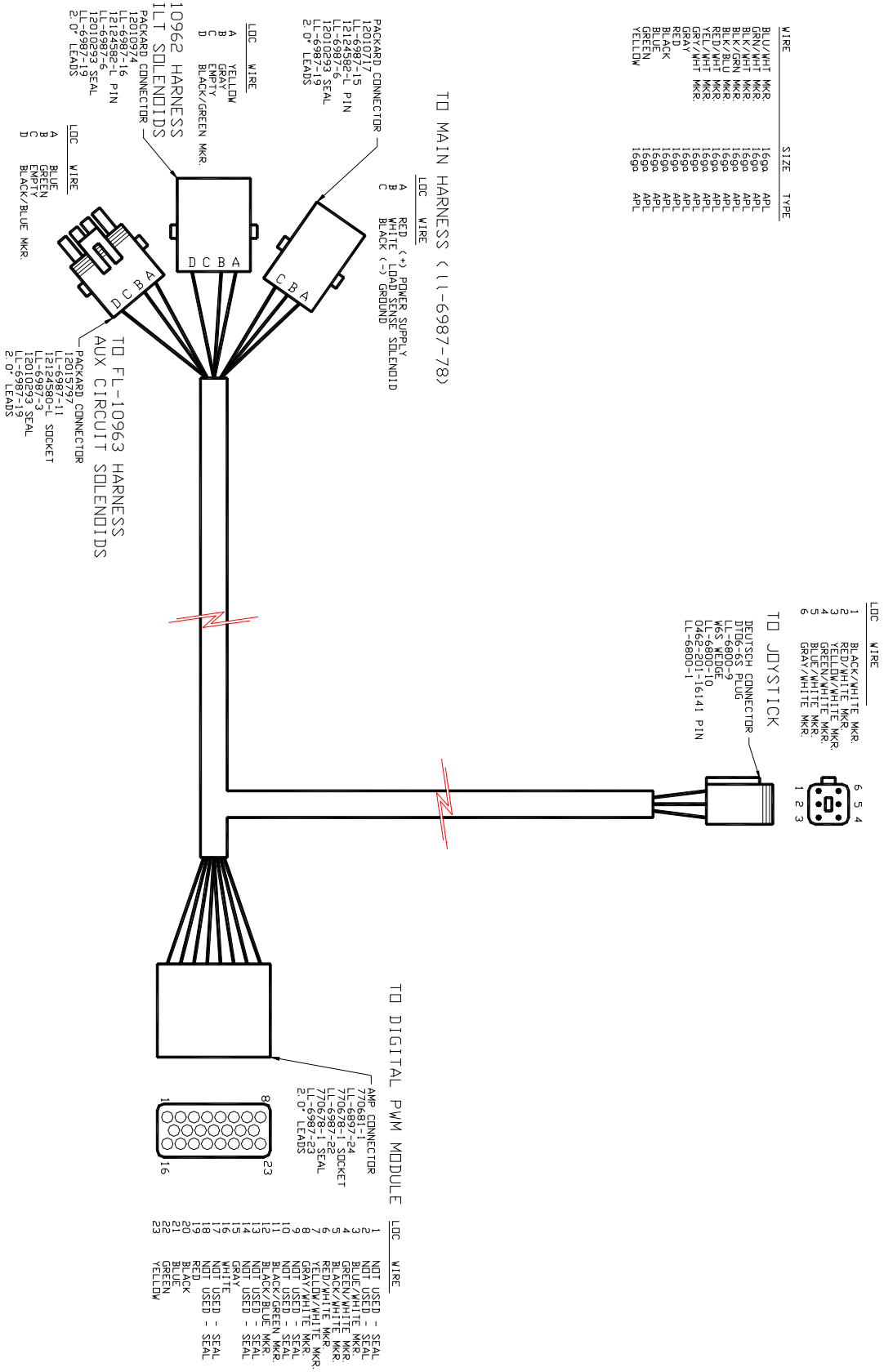




CONNECTOR PINOUTS

PIN#	DESCRIPTION
1	NOT AVAILABLE
2	NOT AVAILABLE
3	PUSHBUTTON – TILT RIGHT
4	PUSHBUTTON – TILT LEFT
5	GROUND TO PUSHBUTTONS
6	+5VDC TO PUSHBUTTONS
7	PUSHBUTTON – TILT DOWN
8	PUSHBUTTON – TILT UP
9	NOT AVAILABLE
10	NOT AVAILABLE
11	VALVE +12V SUPPLY – SWITCHED
12	VALVE +12V SUPPLY – SWITCHED
13	NOT AVAILABLE
14	NOT AVAILABLE
15	FORK TILT UP VALVE
16	AUX 2 – PUMP
17	AUX 1 – NOT USED
18	VALVE +12V SUPPLY – SWITCHED
19	BATTERY 12/24 VDC
20	BATTERY GROUND
21	FORK TILT RIGHT VALVE
22	FORK TILT LEFT VALVE
23	FORK TILT DOWN VALVE

NOTES:
1) THE "VALVE SUPPLY OUT" IS A SWITCHED SUPPLY ONLY PRESENT WHEN THERE IS A SWITCH DEPRESSED.
2) AUX 1 AND AUX 2 ARE HIGH SIDE DRIVE ON/OFF OUTPUTS THE GROUND FOR THESE OUTPUT CAN BE ESTABLISHED EXTERNAL TO THE CARD.
3) THE DIAG LED INDICATES AN OPEN CIRCUIT CONDITION ON ANY OF THE SWITCH INPUTS. VALVE OUTPUT IS DISABLED IF ANY ERROR IS DETECTED.


TO MAIN HARNESS (LL-6987-78)
LOC WIRE
A RED (+) POWER SUPPLY
B WHITE LOAD SENSE SOLENOID
C BLACK (-) GROUND
PACKARD CONNECTOR
12010717
LL-6987-15
12124582-L PIN
LL-6987-6
12010293 SEAL
LL-6987-19
2.0' LEADS
TO FL-10962 HARNESS
FORK TILT SOLENOIDS
PACKARD CONNECTOR
12010674
LL-6987-16
12124582-L PIN
LL-6987-6
12010293 SEAL
LL-6987-19
2.0' LEADS
LOC WIRE
A YELLOW
B GRAY
C EMPTY
D BLACK/GREEN MKR.
LOC WIRE
A BLUE
B GREEN
C EMPTY
D BLACK/BLUE MKR.
TO FL-10963 HARNESS
AUX CIRCUIT SOLENOIDS
PACKARD CONNECTOR
12015797
LL-6987-11
12124580-L SOCKET
LL-6987-3
12010293 SEAL
LL-6987-19
2.0' LEADS
TO JOYSTICK
DEUTSCH CONNECTOR
DT06-6S-P012
LL-6800-9
W6S WEDGE
LL-6800-10
0462-201-16141 PIN
LL-6800-1
LOC WIRE
1 BLACK/WHITE MKR.
2 RED/WHITE MKR.
3 YELLOW/WHITE MKR.
4 GREEN/WHITE MKR.
5 BLUE/WHITE MKR.
6 GRAY/WHITE MKR.
6 5 4
1 2 3
WIRE SIZE TYPE
BLU/WHT MKR. 16ga APL
GRN/WHT MKR. 16ga APL
BLK/WHT MKR. 16ga APL
BLK/GRN MKR. 16ga APL
BLK/BLU MKR. 16ga APL
YEL/WHT MKR. 16ga APL
GRY/WHT MKR. 16ga APL
GRAY 16ga APL
RED 16ga APL
BLACK 16ga APL
BLUE 16ga APL
GREEN 16ga APL
YELLOW 16ga APL
TO DIGITAL PWM MODULE
AMP CONNECTOR
770681-1
LL-6987-24
770678-1 SOCKET
LL-6987-22
770678-1 SEAL
LL-6987-23
2.0' LEADS
1 8
16 23
LOC WIRE
1 NOT USED - SEAL
2 NOT USED - SEAL
3 BLUE/WHITE MKR.
4 GREEN/WHITE MKR.
5 BLACK/WHITE MKR.
6 RED/WHITE MKR.
7 YELLOW/WHITE MKR.
8 GRAY/WHITE MKR.
9 NOT USED - SEAL
10 NOT USED - SEAL
11 BLACK/GREEN MKR.
12 BLACK/BLUE MKR.
13 NOT USED - SEAL
14 NOT USED - SEAL
15 GRAY
16 WHITE
17 NOT USED - SEAL
18 NOT USED - SEAL
19 RED
20 BLACK
21 BLUE
22 GREEN
23 YELLOW

GILMORE-GLOBAL INSTRUMENTS CO INC ECS5901
HOUSTON TX 77017 6-26-00
www.gilmoredist.com 800-999-6632

FUSES | CB 1 | BATTERY | RELAYS

1	5	9	13
2	6	10	14
3	7	11	15
4	8	12	16

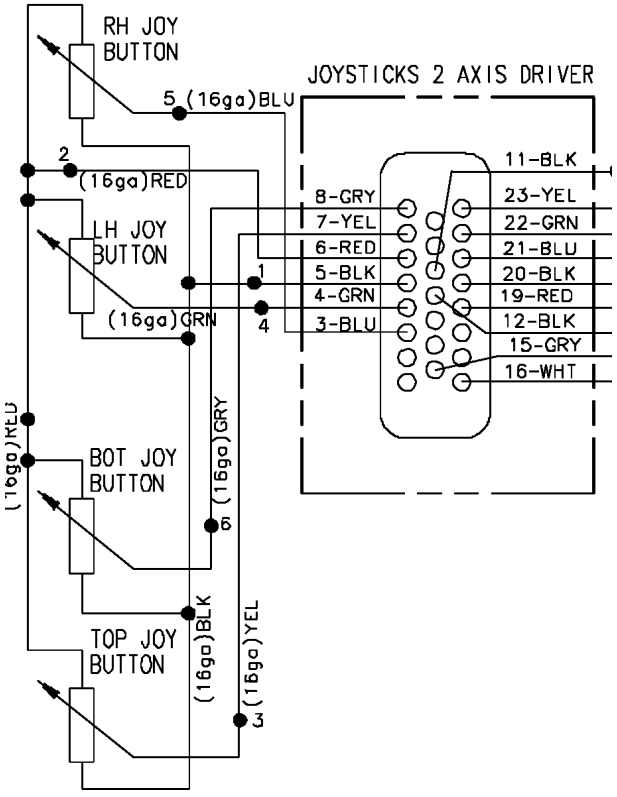
ACCY | IGN | IGN | BATT

	R1	R2	R3	R4
R9	R5	R6	R7	R8

FUSES
1. WIPER (10A)
2. DEFROSTER (5A)
3. ALT (5A)
4. HEATER (10A)
5. FUEL CTRL, SOLONOID (5A)
6. OS C.LIMIT ACCUM CHARGE SW (10A)
7. TRANS SHIFTER (10A)
8. PARK BRAKE (10A)
9. FORK SHIFT (15A)
10. SPARE (10A)
11. SPARE (10A)
12. INST PANEL LIGHTS (5A)
13. TURN SIG & DECLUTCH RELAYS (15A)
14. HORN (15A)
15. FLOOD & BEACON LTS (20A)
16. BOOM & RUNNING LTS (20A)

CIRCUIT BREAKER
1. FUEL SOLENOID (20A) TYPE1

RELAYS
R1=FWD LOCKOUT
R2=REV LOCKOUT & REV ALARM
R3=FULL OSC LOCK
R4=ACCY FUSE BLOCK
R5=VOLT LT.&HOURMETER
R6=OSC. LIMIT
R7=HORN
R8=STARTER LOCKOUT
R9=AUX LOAD SENSOR



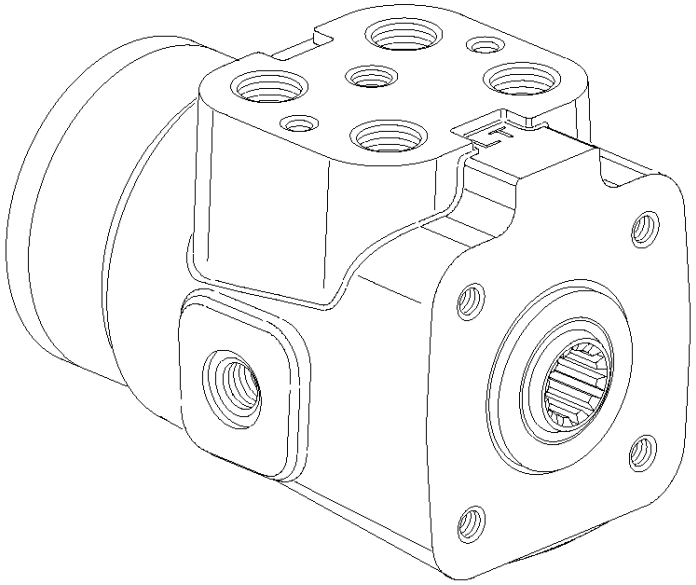
JOYSTICK SCHEMATIC SYMBOL

JOYSTICK-PWM TROUBLESHOOTING

SYMPTOM	PROBABLE CAUSE	REMEDY
No power to PWM Module	Check fuse #F9 (15A)	Replace if necessary.
	Loose connections	Check harness for loose or mis-aligned pins to driver board connection, 3-way plug.
	Incorrect system voltage	Verify that system voltage is available to driver board between pin 19 (+) and pin 20 (-) on the driver connector. If voltage is present and LED does not light, replace driver board.
Power LED on, Diagnostic LED on	Open circuit in joystick inputs.	Verify 5VDC to joystick pin 2 (+) and pin 1 (-) . If no voltage, check driver to joystick harness for continuity. If continuity, replace driver card.
		Verify stand-by reference voltage from joystick, .5VDC-1.2VDC pin 3 to pin 1, pin 4 to pin 1, pin 5 to pin 1 and pin 6 to pin 1. If one or more not present check plug for bad or broken pins. If no pins are bad, replace joystick or joystick switch.
		If stand-by voltage is present at joystick plug, check harness continuity at plug and driver on all 4 input wires. If one or more fails continuity, repair or replace harness
		NOTE: STAND-BY REFERENCE VOLTAGE MUST BE PRESENT ON ALL 4 DRIVER CONTROL INPUTS TO CANCEL INPUT FAILURE LED AND OUTPUT LOCKOUT FUNCTION EVEN WHEN UNIT IS NOT EQUIPPED WITH AUX. FORK ROTATE VALVE AND CIRCUIT.
Operates in one direction only	Threshold minimum voltage lockout	If the input of one directional control button stand-by voltage is slightly above 1.4VDC, but not high enough to allow the driver board to supply minimum current necessary to shift the hydraulic valve control spool thereby locking its opposite button control out. If this is suspected, switching the input wires of the affected circuit will cause the lockout switch (i.e. up to down or left to right) to opposite of the original fault. Replace the joystick button if that appears to work.

SYMPTOM	PROBABLE CAUSE	REMEDY
Operates in one direction only	Incorrect pilot pressure or bad solenoid	Verify hydraulic solenoid valve operation by switching plugs on the valve and depressing control buttons. If control switches direction, replace solenoid coil and/or check hydraulic pilot pressure. Verify solenoid coil continuity and resistance with ohmmeter. Proper coil resistance at 70° F is approx. 5.2 ohm for main valve (L90) coils, and 6 ohm for aux. solenoid valve(D1VW) coils. NOTE: COIL RESISTANCEWILL VARY WITH TEMPERATURE VARIATION.
No output functions	Bad continuity or driver board.	Verify line voltage present at pin D measured to ground (Frame) on Packard 4 pin output plug when control button is depressed. If not present, verify continuity of harness between pin D and pin 11of the 23 pin amp plug for fork up-down. For fork rotate left-right, verify continuity betwen pin D and pin 12 of the 23 pin amp plug. If continuity is good, replace driver board.
Sluggish or slow operation of fork rotate.	Bad driver board or aux, load sense relay.	To verify pump load sense operation, measure line voltage present on pin B of Packard 3 position plug when fork rotate button (either) is depressed. If not present, verify harness continuity between pin C and pin 16 of the 23 pin amp connector. If continuity is good, replace driver board. If voltage is present, verify aux. load sense relay operation by checking that voltage is removed from charge valve solenoid coil pin A to ground when either fork rotate button is depressed. If voltage remains constant, replace aux. load sense relay.
Sluggish or slow operation of Fork Tilt		To verify actual full stroke operation of the valve control solenoids, insert an ammeter in line with pin D on both output 4 position connectors, pos (+) toward driver board, neg (-) toward valve. Full stroke current readings obtained with button fully depressed are: Fork Up: 1.0A, Fork Down: 1.0A, Fork CW: 1.75A, Fork CCW: 1.75 A (See note1, 2, and 3 below).
		NOTE 1: FULL STROKE CURRENT READING OF AUX. FORK ROTATE WILL CHANGE FROM 1.75 a TO 2.0 a 8/01/01 TO ACCOMODATE FULL FLOW TO AUX FUNCTION.
		NOTE 2: BECAUSE THE DRIVER OPERATION IS CURRENT COMPENSATED, VOLTAGE READINGS TAKEN ACROSS THE OPERATOR COILS WILL VARY WITH TEMPERATURE AND ARE THEREFORE NOT AN ACCURATE INDICATOR OF DRIVER PERFORMANCE.
		NOTE 3: TEST LIGHTS ARE NOT RECOMMENDED SINCE THE LIGHT WILL DIVERT A SIGNIFICANT PORTION OF THE DRIVER OUTPUT CURRENT AND WILL ALTER VALVE PERFORMANCE.

STEERING ORBITROL

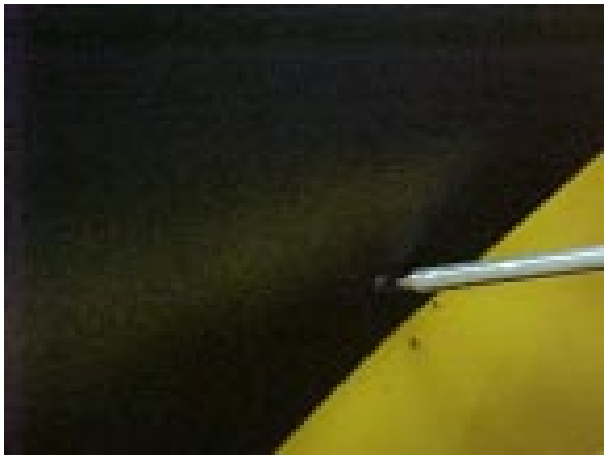


The steering orbitrol supplies oil pressure to the steering selector valve for distribution to the steering cylinders. The pressure is created by rotation of the steering wheel. The orbitrol is mounted under the instrument panel.

ORBITROL REMOVAL

1. First remove the push screws from both sides of the dash by popping out with a pen light or small screwdriver. These can be reused.

Left Side



Right Side

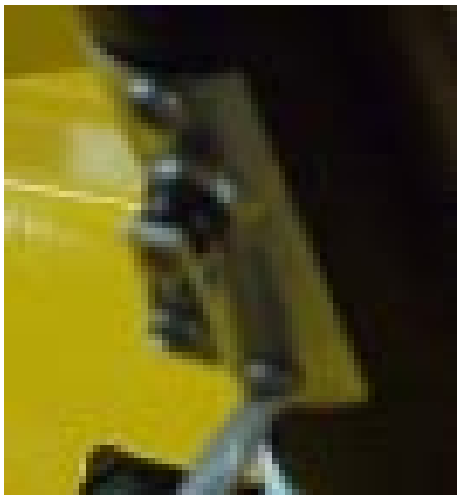
2. Then remove the horn cover, horn wire, steering wheel and horn button cover and button from the steering column.

Cover

Horn Wire

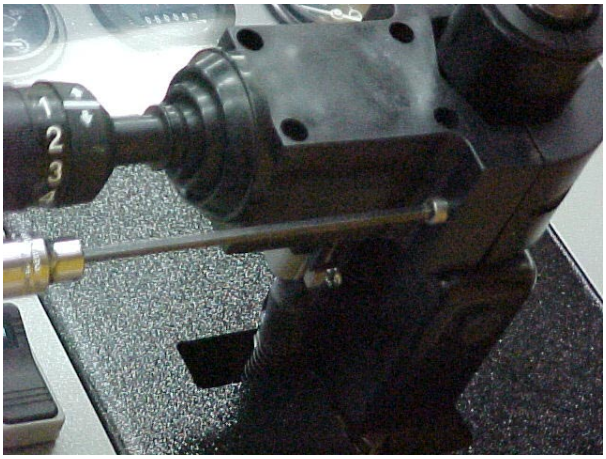
Steering Wheel

Horn Button Cover



Horn Button

3. Remove the shifter assembly from the column by removing the 2 allen head bolts. NOTE: WHEN REINSTALLING TAKE CARE NOT TO OVERTIGHTEN. OVERTIGHTENING CAN STRESS THE PLASTIC AND IT COULD BREAK. SEE TORQUE SPECS.

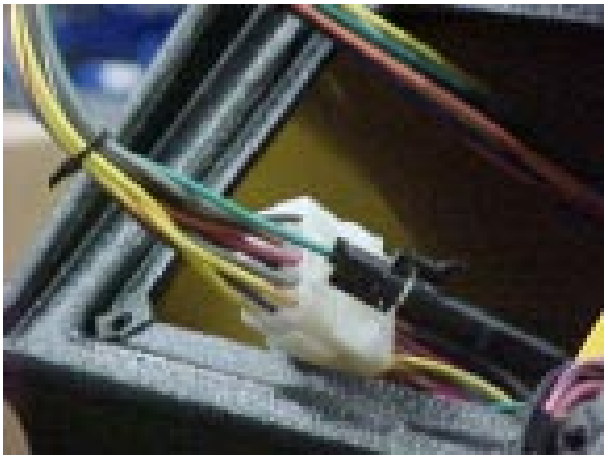


Shifter Assembly

4. Now remove the left hand panel from the dash and disconnect all wire connections.

Left side dash panel

Parking brake and clutch cut-off connection



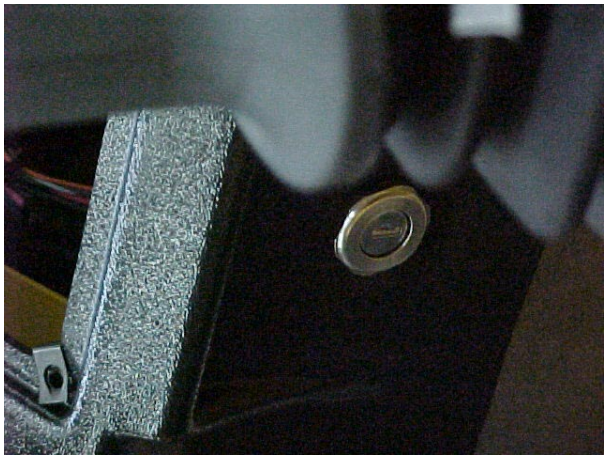
Left side panel wiring harness connections

5. Remove the right side panel cover and all connections next.

Right panel with optional lighting switches.

Right panel connections.

6. Remove key switch nut and cover from dash.



Key switch nut.

Dash cover with removed panels

7. Remove the lower dash panel by removing the knob and all 6 screws.

Lower dash panel.

Lower dash panel knob.

Dash panel screw.

Removing the panel

8. Unwrap wires from left side off of steering column to make access to column easier.

9. Disconnect hoses and cap ports to prevent contamination.

10. Remove the four bolts with lockwashers from the frame. NOTE: If you need to replace the bolts that were removed at this point, do not use bolts longer than 5/8". Longer bolts will damage the orbitrol.

11. Loosen clamp assembly on upper cover of steering column and remove from machine.

Reassembly

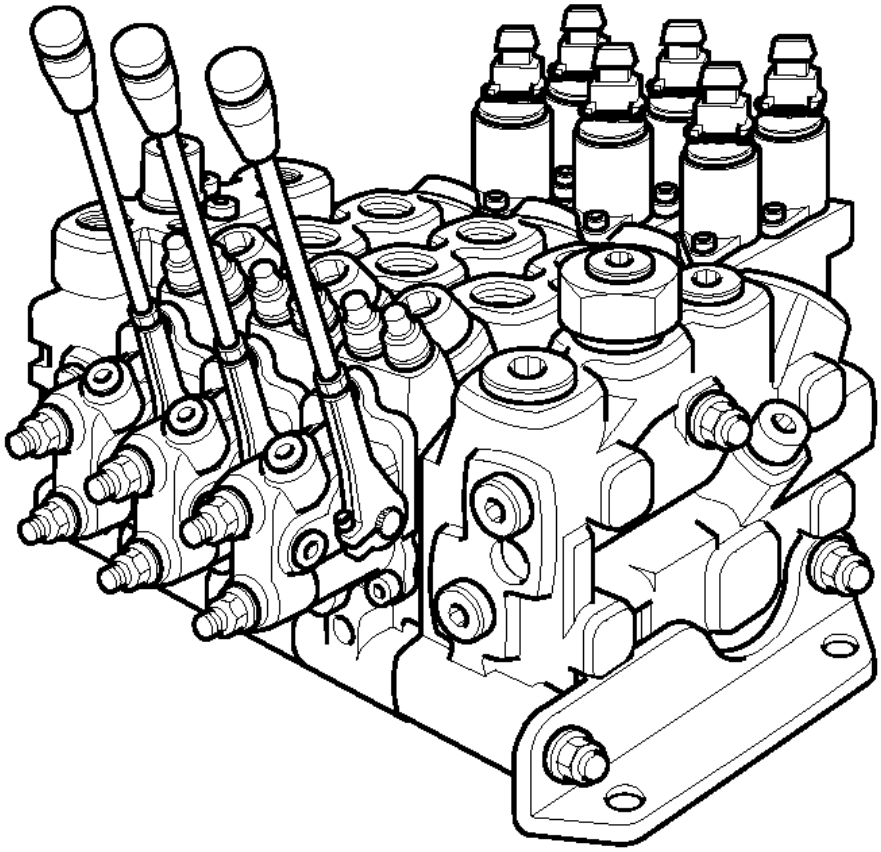
For installation, simply follow the steps in the reverse order. When installation is complete, start the machine and operate the steering from one extreme to the other several times to purge any air that may be trapped in the valve and lines. Then, check the fluid level in the hydraulic reservoir.

Torque Specifications

Clamp = 20 foot/pounds
Steering Wheel Nut = 32-37 foot/pounds
Shifter Assy Bolts = 18 inch/pounds

Horn Button.

1. Remove the horn cover, horn wire, steering wheel and horn button cover and button from the steering column. You will also need to unbolt the clamp from the upper column to remove the wire. Use proper torque specifications when reassembling.

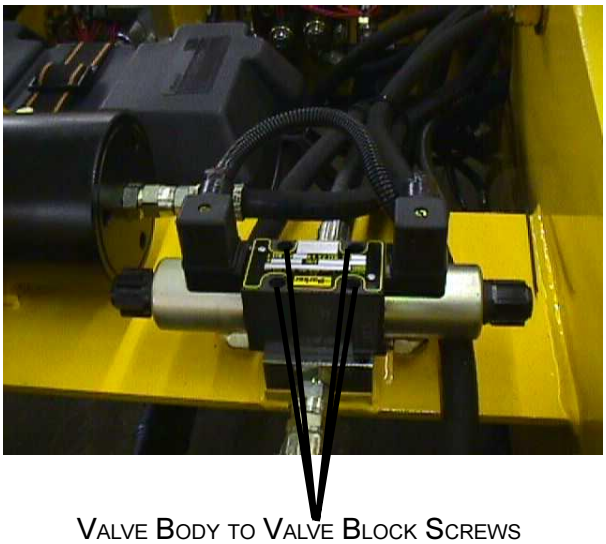


Steering Selector Valve

The steering selector valve receives oil from the orbitrol and distributes it to the steering cylinders. The distribution of oil is controlled by a switch mounted on the dash. The switch provides the following steering functions:

1. Two-wheel steer
2. Four-wheel steer
3. Oblique (crab) steer

The selector valve is mounted in front of the battery box.



Valve Body to Valve Block Screws

Steering Selector Valve Removal

1. First remove figerglass cover and disconnect electrical connection on solenoid.
2. Remove the four (4) screws that hold the valve body to the valve block.
3. Remove hoses from valve block. Match mark the four hydraulic lines that connect the selector valve to the orbitrol. As they are disconnected, cap or plug the fittings and lines as they are disconnected to prevent contamination. Also, be sure to use a container to catch the hydraulic oil that will spill.

NOTE: DISPOSE OF OIL PROPERLY. DO NOT POUR ON THE GROUND, INTO SEWERS OR INTO BODIES OF WATER.

4. Next, remove the 2 screws that anchor the valve block to the mounting plate.
5. Remove the fittings from the valve block and remove the valve block from the machine.

For installation, simply follow the steps in the reverse order. When installation is complete, start the machine and operate the steering from one extreme to the other several times to purge any air that may be trapped in the valve and lines. Then, check the fluid level in the hydraulic reservoir and fill as necessary.

SYMPTOM	PROBABLE CAUSE	REMEDY
Steering has 2 wheel steer only	Defective fuse.	Verify 12 VDC present to steer switch on gry/red lead. If present, replace fuse #10.
No 4 wheel steer.	Defective switch.	Verify 12 VDC present between pin 1 (org +) and pin 2 (blk -) on solenoid B plug of steering valve. If absent, replace switch.
No crab steer.		Verify 12 VDC present between pin 1 (blu +) and pin 2 (blk -) of solenoid A plug of steering valve. If absent, replace switch.
	Defective solenoid coil.	Verify resistance of affected coil of 4.8 ohms. If open or high, replace coil or valve.
	Defective valve.	If electric check ok, replace valve.

NOTES

All hydraulic cylinders on this machine are double-acting. Oil entering the base end port of the cylinder extends the rod. Oil entering the rod end port retracts the rod.

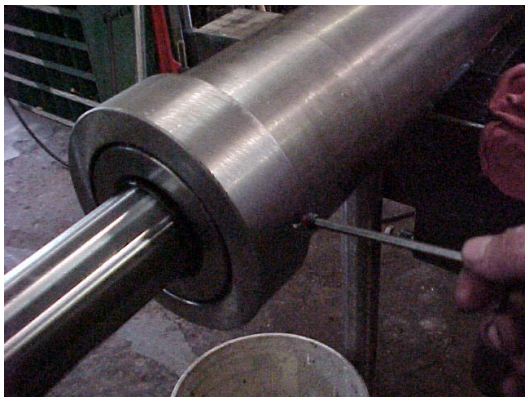
DISASSEMBLY OF CYLINDER (GENERIC)

1. Place a suitable container below the cylinder to catch the oil when the rod assembly is pulled out.

ATTENTION!

Properly dispose of the oil removed from cylinder. Do not pour oil on the ground, into sewers or into bodies of water.

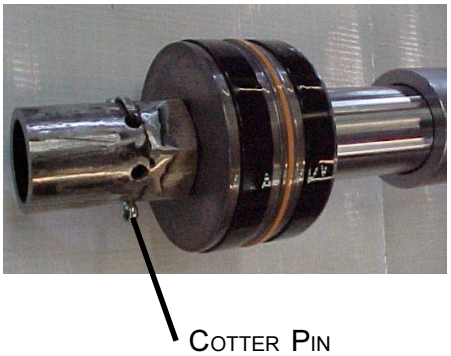
2. Remove set screw from collar.



3. Using a strap or chain wrench, unscrew the collar.

4. Use a suitable puller to remove the piston rod assembly from the barrel.

5. Remove cotter pin from piston lock nut. Unfasten lock nut. Slide piston, spacer and head from rod.



6. Remove all software from head and piston. Discard software.

7. Wash all metal parts in an approved cleaning solvent and dry thoroughly with a clean, lint-free cloth.

8. Inspect barrel, rod and piston for nicks, scratches and scoring.

9. Replace any damaged parts and seals as necessary.

ASSEMBLY OF CYLINDER (GENERIC)

NOTICE

The collar end of the head is referred to as the large end. The opposite end is the small end.

Use new software for assembly. Refer to parts manual for part numbers of cylinder components.

1. Coat new software with clean hydraulic oil.

2. Install head o-ring and head back-up ring in groove on outside diameter of head. O-ring must be closest to small end of head.

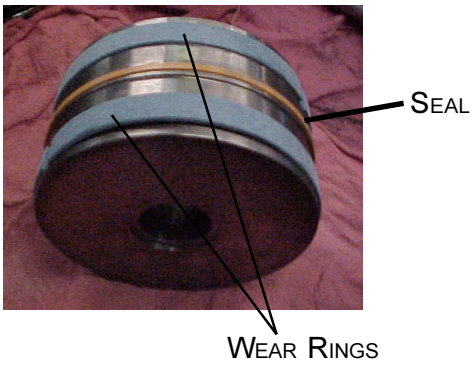
3. Install head wear ring in large groove on inside diameter of head.

4. Install rod seal and modular back-up ring in second largest groove inside head. Lips of rod seal must face small end of head. Modular back-up ring must be closest to large end of head.

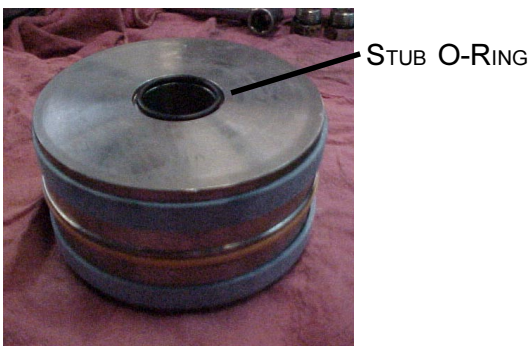
5. Install rod wiper in groove on large end of head with wiper lips facing large end.

6. Install piston seal in center groove on outside diameter of piston.

7. Install the piston wear rings (2) in remaining grooves on outside diameter of piston.



8. Install stub o-ring in groove on inside diameter of piston.

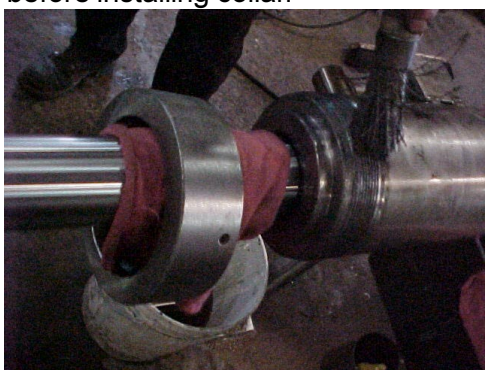


9. Carefully slide collar on rod, then the head. Use caution to prevent cutting the wiper on the rod.

10. Slide spacer on rod, then the piston.

11. Fasten piston lock nut on end of rod. Insert new cotter pin through nut.

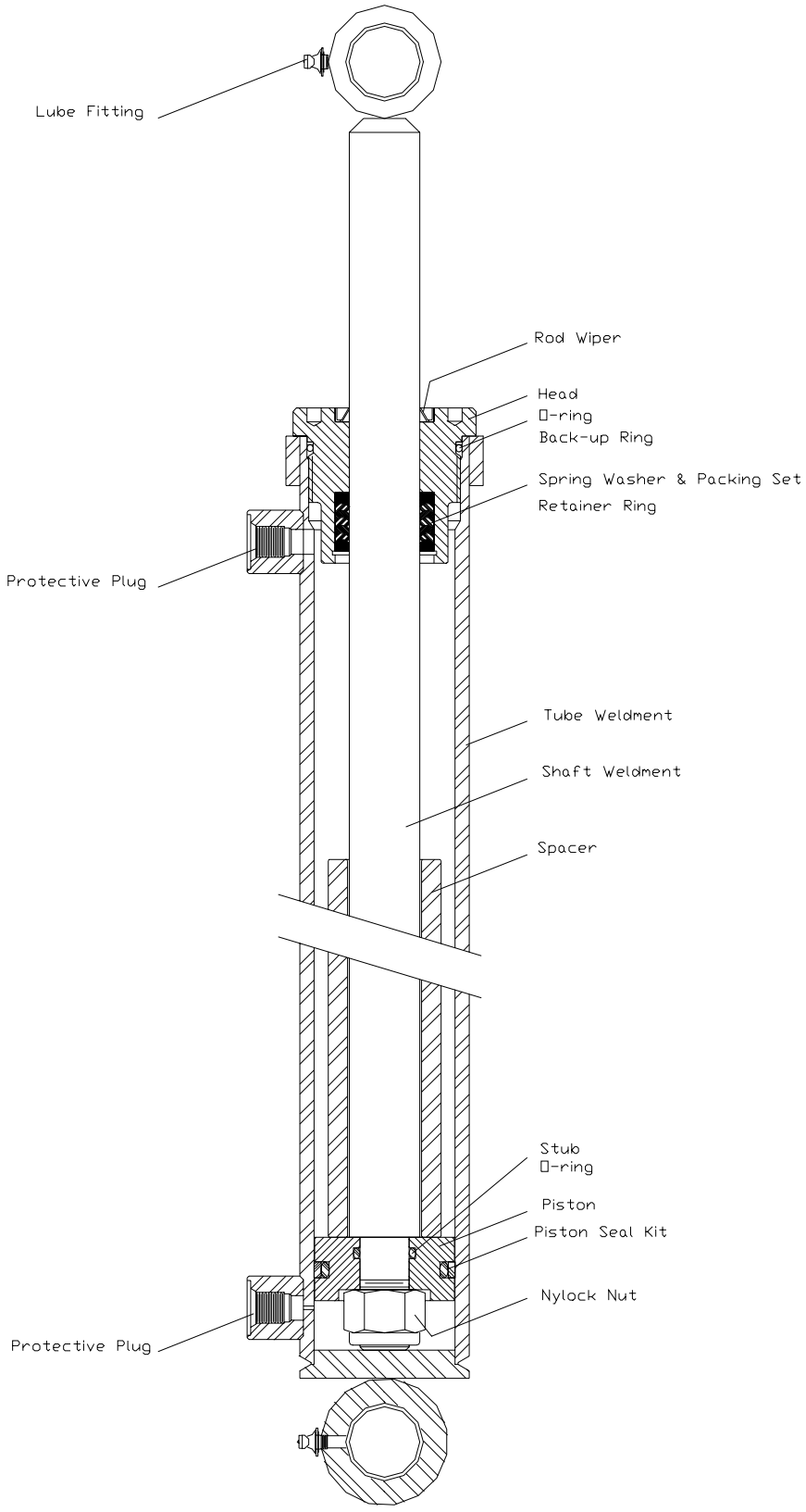
12. Insert piston rod assembly into cylinder barrel. Lubricate threads with anti-seize before installing collar.



13. Fasten collar on barrel with strap or chain wrench.

14. Install NEW set screw with nylatron tip on collar.

CYLINDER COMPONENTS



REMOVAL OF LIFT CYLINDER

⚠WARNING!

Heavy components! Before removing cylinder, check the weight and make provisions for attaching and lifting. Consider what removal of the component will do to the stability of the machine. Use a hoist capable of supporting the weight. A slipping or falling component may result in serious injury or death to personnel.

1. Park machine on a firm, level surface. Engage parking brake.

2. Raise boom approximately two feet above carry position and support from shop floor or ground.

3. Clean hydraulic connections at cylinder with a cleaning solvent.

4. Match-mark hydraulic lines and cylinder ports to ensure correct connections during installation.

5. Disconnect hydraulic lines from cylinder. Cap the lines and cylinder ports to prevent contamination.

6. Secure a suitable lifting strap from hoist to cylinder.

7. Remove capscrew and nut from cylinder rod pin. Pull out pin with a suitable puller to disconnect cylinder from boom.

8. Remove capscrew and nut from cylinder base pin. Pull out pin to disconnect cylinder from frame.

9. Lift cylinder away from machine and place on suitable supports.

Installation of Lift Cylinder

⚠WARNING!

Heavy components! Before installing cylinder, check its weight and make provisions for attaching and lifting. Use a hoist capable of supporting the weight. A slipping or falling component may result in serious injury or death to personnel.

1. Secure a suitable lifting strap from hoist to cylinder. Lift the cylinder into position on machine and align base end between cylinder mounts.

2. Drive pin through base end of cylinder and secure with capscrew and nut. Remove lifting strap. Note: Capscrew MUST have locktight applied.

3. Connect hydraulic lines to cylinder.

4. Start engine and apply down pressure to fill cylinder with oil.

5. Extend cylinder to align rod end between cylinder mounts on boom.

6. Drive pin through rod end and secure with capscrew, lockwasher and nut.

7. Add oil to 'FULL' mark on reservoir dipstick.

8. Check hydraulic connections at cylinder for leakage. Inspect for excessive leakage at rod wiper. (It is normal for a light film of oil to adhere to the rod.)

Torque Specifications

Base Pin = 80 foot/pounds.

Lift Cylinder on hoist

Lift Cylinder Base Pin

Torque capscrew to proper specification.

LIFT CYLINDER TROUBLESHOOTING

SYMPTOM	PROBABLE CAUSE	REMEDY
Cylinder will not operate when joystick is actuated	Failed hose or hose connections leaking.	Replace hose or tighten loose connections.
	Low oil level in reservoir.	Add oil to “FULL” mark on reservoir dipstick.
	Plugged sump strainer.	Clean strainer.
	Insufficient pilot pressure supplied to main valve.	Check pilot pressure with a 600 psi pressure gauge. Correct pressure should be 300(±25) psi.
	Oil bypassing spool in main valve.	Replace defective spool seal(s).
	Rod wiper leaking excessively.	Replace defective wiper.
	Oil bypassing cylinder piston.	Replace defective piston seal.
	Faulty pump operation.	Repair or replace pump.
	Load larger than capacity.	Reduce to rated load capacity at rated load center.
Cylinder drifts (will not remain in position)	Oil bypassing spool in main valve.	Replace defective spool seal(s).
	Oil bypassing counterbalance valve cartridge.	Replace defective cartridge seal(s).
	Oil bypassing cylinder piston.	Replace defective piston seal.
Cylinder drifts (will not remain in position)	Spool not centered in main valve.	Replace spool centering springs.
	Load larger than capacity.	Reduce to rated load capacity at rated load center

Removal of Frame Tilt Cylinder

⚠WARNING!

Heavy components! Before removing cylinder, check its weight and make provisions for attaching and lifting. Consider what removal of the component will do to the stability of the machine. Use a hoist capable of supporting the weight. A slipping or falling component may result in serious injury or death to personnel.

1. Park machine on a firm, level surface. Engage parking brake.

2. Install blocking to prevent unit from tipping when cylinder is removed.

3. Clean hydraulic connections at cylinder with a cleaning solvent.

4. Match-mark the hydraulic lines and cylinder ports to ensure correct connections during installation.

5. Disconnect hydraulic lines from cylinder. Cap the lines and cylinder ports to prevent contamination.

6. Secure a suitable lifting strap from hoist to cylinder.

7. Remove capscrew and nut from cylinder rod pin. Pull out pin with a suitable puller.

8. Remove capscrew and nut from cylinder base pin. Pull out pin to disconnect cylinder from machine.

9. Lift cylinder away from machine and place on suitable supports.

Installation of Frame Tilt (Sway) Cylinder

⚠WARNING!

Heavy components! Before installing cylinder, check its weight and make provisions for attaching and lifting. Use a hoist capable of supporting the weight. A slipping or falling component may result in serious injury or death to personnel.

1. Secure a suitable lifting strap from hoist to cylinder. Lift the cylinder into position on main frame and align base end between cylinder mounts.

2. Drive pin through base end of cylinder. Apply locktight to capscrew and secure pin with capscrew and nut. Remove lifting strap.

3. Connect hydraulic lines to cylinder.

4. Start engine and apply retract pressure to fill cylinder with oil.

5. Extend cylinder to align rod end between cylinder mounts and cradle.

6. Drive pin through rod end and secure with capscrew and nut.

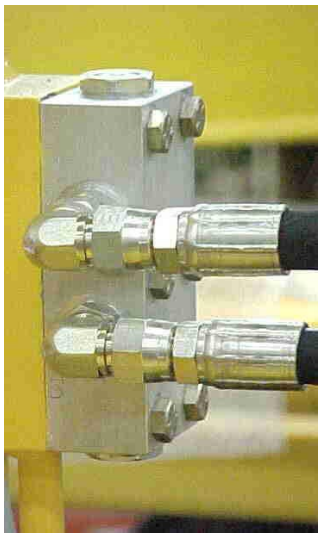
NOTE: APPLY LOCKTIGHT TO CAPSCREW.

7. Operate cylinder several times to remove air from circuit. (Cylinder may initially operate jerky because of trapped air.)

8. Add oil to “FULL” mark on reservoir gauge.

9. Check hydraulic connections at cylinder for leakage. Inspect for excessive leakage at rod wiper. (It is normal for a light film of oil to adhere to the rod.)

Align base end of cylinder between frame mounts



Connect hydraulic lines to cylinder

Insert pin

Fully installed Sway Cylinder

Drive pin through and secrure with capscrew and nut. Use Locktight on capscrew before inserting and torque to proper specs.

FRAME TILT CYLINDER TROUBLESHOOTING

SYMPTOM	PROBABLE CAUSE	REMEDY
Cylinder will not operate when toggle switch is actuated	Failed hose or hose connections leaking.	Replace hose or tighten loose connections.
	Low oil level in reservoir.	Add oil to 'FULL' mark on reservoir gauge.
	Oil bypassing spool in main valve.	Replace defective spool seal(s).
	Rod wiper leaking excessively.	Replace defective wiper.
	Oil bypassing cylinder piston.	Replace defective piston seal.
	Faulty pump operation.	Repair or replace pump.
	Oil bypassing cylinder piston.	Replace defective piston seal.
Cylinder drifts (will not remain in position)	Oil bypassing dual pilot check valve on cylinder.	Replace defective check valve ball(s) or spring(s).
	Oil bypassing spool in main valve.	Replace defective spool seal (s).
	Spool not centered in main valve.	Replace spool centering springs.

REMOVAL OF FORK TILT CYLINDER

⚠WARNING!

HEAVY COMPONENTS! BEFORE REMOVING FORK CARRIAGE AND CYLINDER, CHECK THEIR WEIGHT AND MAKE PROVISIONS FOR ATTACHING AND LIFTING. CONSIDER WHAT REMOVAL OF THESE COMPONENTS WILL DO TO THE STABILITY OF THE MACHINE. USE A HOIST CAPABLE OF SUPPORTING THE WEIGHT. A SLIPPING OR FALLING COMPONENT MAY RESULT IN SERIOUS INJURY OR DEATH TO PERSONNEL.

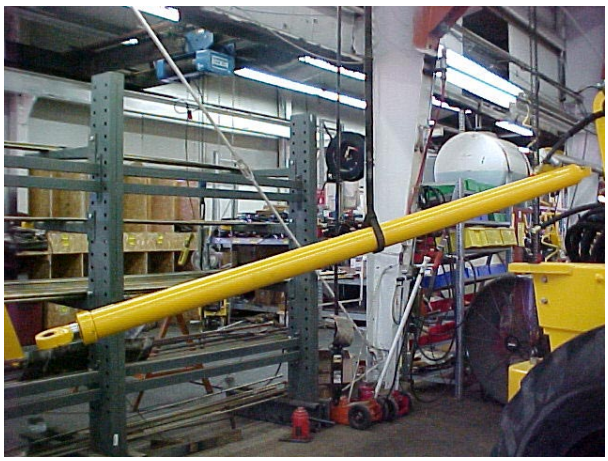
Refer to 8,000 pound boom section further in this group for removal and installation.

Removal of Traverse Cylinder

To remove the traverse cylinder, perform the installation in reverse order.

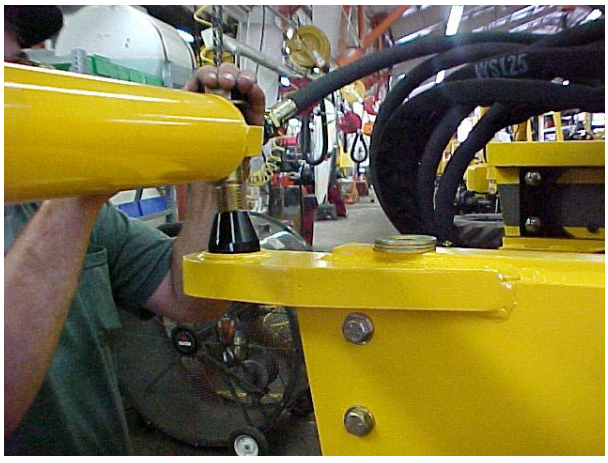
Installation of Traverse Cylinder

1. Using a suitable lifting device, lift the cylinder to the appropriate height for installation.



Lifting the cylinder into position.

2. Line the cylinder in position above the rear mounting cone. Insert bolt with washer at head of bolt.



Lining up the cylinder, mounting cone, and bolt.

3. Tighten bolt and nut to 800 ft-lbs.

Tightening Rear Bolt.

4. Swing cylinder toward frame and place on stand. This will allow for repositioning of the lifting strap.

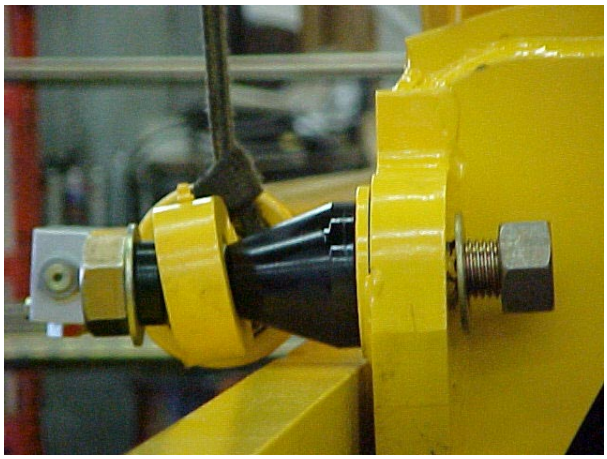
Placing cylinder on stand.

5. Pull or push the carriage to a position that lines up the rod end of the cylinder with the front mount.

Re-location of lifting strap and lining up of the front mount.

6. Hold the mounting cone in place while lining up the cylinder and inserting the front bolt.

POSITIONING THE FRONT MOUNTING CONE.

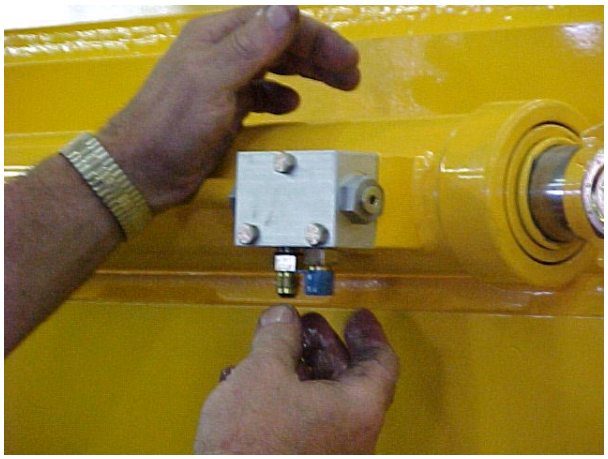


CYLINDER, MOUNTING CONE, BOLT, AND NUT.

7. Tighten bolt and nut to 800 ft-lbs.

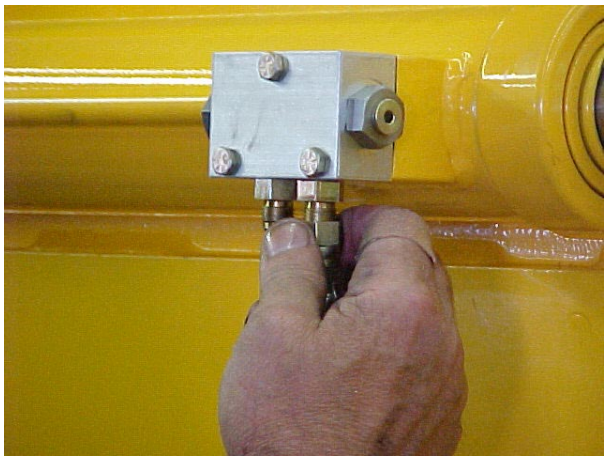
TIGHTENING OF FRONT BOLT AND NUT.

8. Remove protective caps from valve block.



PROTECTIVE CAPS ON VALVE BLOCK.

9. Attach hoses to fittings on valve block.



10. Apply grease to using the fittings at each end of the cylinder.

TRAVERSE CYLINDER TROUBLESHOOTING

SYMPTOM	PROBABLE CAUSE	REMEDY
Cylinder will not operate when joystick is actuated	Failed hose or hose connections leaking.	Replace hose or tighten loose connections.
	Low oil level in reservoir.	Add oil to 'FULL' mark on reservoir GAUGE.
	Insufficient pilot pressure supplied to main valve.	Check pilot pressure with a 600 psi pressure gauge. Correct pressure should be 300(±25) psi.
	Oil bypassing spool in main valve.	Replace defective spool seal (s).
	Rod wiper leaking excessively.	Replace defective wiper.
	Oil bypassing cylinder piston.	Replace defective piston seal.
	Faulty pump operation.	Repair or replace pump.
	Load larger than capacity.	Reduce to rated load capacity at rated load center.
Cylinder drifts (will not remain in position)	Oil bypassing spool in main valve.	Replace defective spool seal(s).
	Oil bypassing cylinder piston.	Replace defective piston seal.
	Oil bypassing counterbalance valve cartridge.	Replace defective cartridge seal (s).
	Spool not centered in main valve.	Replace spool centering springs.
	Main relief valve not holding.	Clean cartridge or replace.
	Load larger than capacity.	Reduce to rated load capacity at rated load center.

REMOVAL/INSTALLATION OF STEERING CYLINDER

⚠WARNING!

HEAVY COMPONENTS! BEFORE REMOVING/ INSTALLING CYLINDER, CHECK ITS WEIGHT AND MAKE PROVISIONS FOR ATTACHING AND LIFTING. CONSIDER WHAT REMOVAL OF THE COMPONENT WILL DO TO THE STABILITY OF THE MACHINE. USE A HOIST CAPABLE OF SUPPORTING THE WEIGHT. A SLIPPING OR FALLING COMPONENT MAY RESULT IN SERIOUS INJURY OR DEATH TO PERSONNEL.

Refer to your Carraro Axle Manual for steering cylinder removal and installation.

NOTE: THIS CYLINDER IS DESIGNED TO BE REPLACED WHEN THERE IS A PROBLEM WITH IT, RATHER THAN BEING REBUILT. FOR REPLACEMENT PART NUMBERS REFER TO THE PARTS MANUAL.

Removal of Fork Frame Side Tilt Cylinder

⚠WARNING!

Heavy components! Before removing cylinder, check its weight and make provisions for attaching and lifting. Consider what removal of the component will do to the stability of the machine. Use a hoist capable of supporting the weight. A slipping or falling component may result in serious injury or death to personnel.

1. Park machine on a firm, level surface. Engage parking brake.

2. Lower fork frame to floor or ground to prevent tipping of the fork frame when cylinder is removed.

3. Clean hydraulic connections at cylinder with a cleaning solvent.

4. Match-mark the hydraulic lines and cylinder ports to ensure correct connections during installation.

5. Disconnect hydraulic lines from cylinder. Cap the lines and cylinder ports to prevent contamination.

6. Secure a suitable lifting strap from hoist to cylinder.

7. Remove capscrew, lockwasher, and nut from cylinder rod pin. Pull out pin with a suitable puller.

8. Remove capscrew, lockwasher and nut from cylinder base pin. Pull out pin to disconnect cylinder from machine.

9. Lift cylinder away from machine and place on suitable supports.

Extension Cylinder Installation/Removal

Refer to boom section.

In our brake system oil comes from the hydraulic pump and flows through the main directional valve to the steering/brake pressure reducing valve.

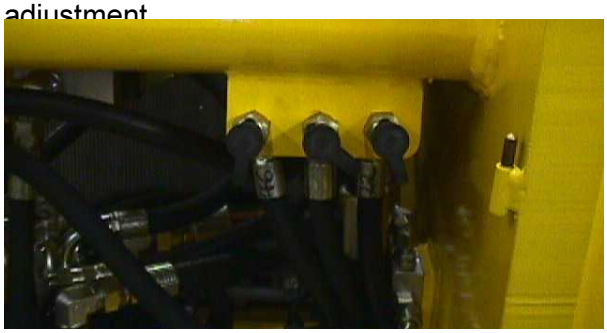
The pressure readings that can be obtained from the the main pressure test port will should be 3450 psi, all others are load sense at 3250 psi. Here are some conditions and corresponding pressures that could be obtained at this location:

- At machine startup with no functions being actuated: 500-1000 psi, until the accumulator is charged, then system pressure of 500 psi.
- Machine running with no functions being actuated: 500 psi.
- Brakes only: 500 psi, until the accumulator pressure drops below 1000 psi, then 500-1000 psi. This is only until the Low Limit Pressure Switch reads accumulator pressure of 1000 psi or more, then the reading will be 500 psi.
- Machine operating normally: 500-3450 psi.
- Machine sitting idle, initially reading 500 psi and then turning the steering wheel: 500-2500 psi.
- Deadheading any function: 3000-3450 psi.

Pressures read at this port may be between 500-3450 psi, depending upon which functions are being actuated, if any at all.

BRAKE PRESSURE CHECK

The brake pressure test port and the steering pressure test port are the same, so they will have the same pressure reading. For doing an adjustment, refer to the steering pressure adjustment.



PRESSURE TEST PORTS

POWER BRAKE VALVE

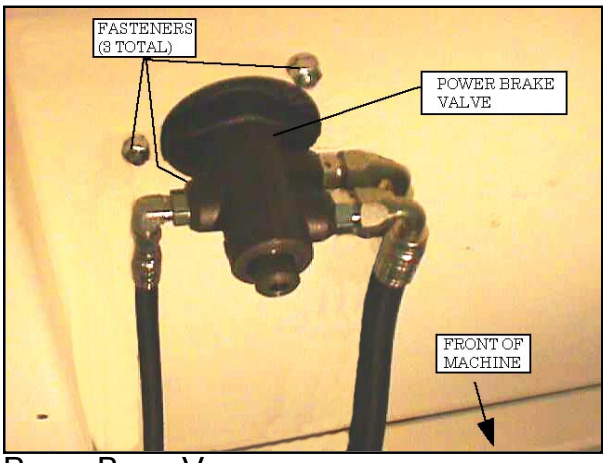
The power brake valve applies oil pressure to the pistons in the disc brake calipers. The pressure is created by actuation of the brake pedal. The power brake valve is located under the floor of the operator's compartment.

REMOVAL OF POWER BRAKE VALVE

1. Remove the (5) capscrews, (5) lockwashers and (5) flat washers from the access cover under the floor of the operator's compartment. Remove the cover.

ACCESS COVER LOCATION

2. Thoroughly clean the power brake valve and hydraulic connections with an approved cleaning solvent.

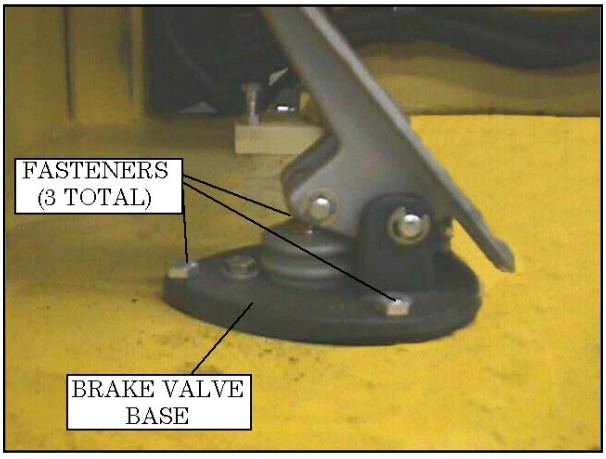


POWER BRAKE VALVE

3. Match-mark the hydraulic lines and valve ports to ensure correct connections during installation.

4. Disconnect hydraulic lines from valve. Cap the lines and valve ports to prevent contamination.

5. Remove the (3) capscrews which secure the valve base to the floor. Remove valve.



BRAKE VALVE MOUNTING CAPSCREWS

POWER BRAKE VALVE SERVICE INFORMATION

For complete service information on the power brake valve, refer to the Mico Service Publication included in this manual.

INSTALLATION OF POWER BRAKE VALVE

1. Install the valve in the floor of the operator's compartment and secure with the (3) capscrews.

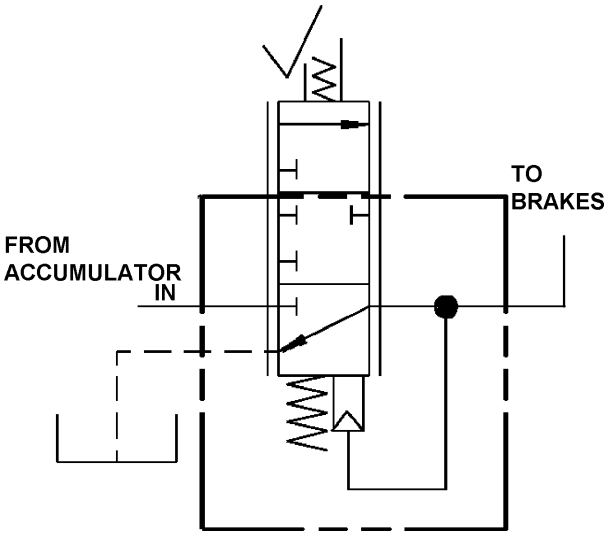
2. Connect hydraulic lines to valve.

3. Bleed the brake lines by following the procedure indicated in the Mico Service Publication.

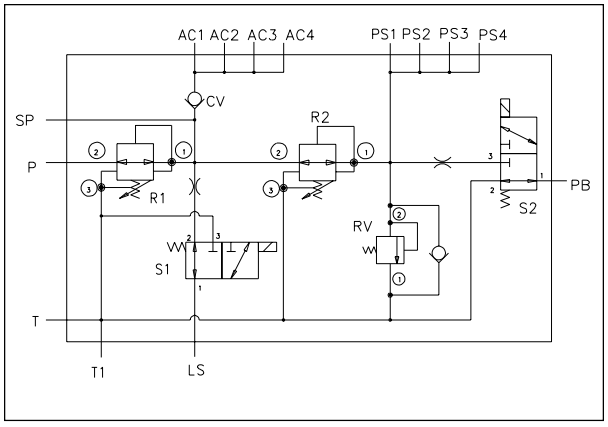
4. Start engine and actuate brake pedal to ensure correct operation. Inspect valve for leaks.

5. Install the access cover under the operator's compartment and secure with the (5) capscrews, (5) lockwashers and (5) flat washers.

BRAKE PEDAL SCHEMATIC SYMBOL



BRAKE CHARGING MANIFOLD SCHEMATIC SYMBOL



SERVICE CHECKS FOR BRAKE SYSTEM

SYMPTOM	PROBABLE CAUSE	REMEDY
Accumulator charging cycle repeats frequently when accumulator is not normally being discharged in service	Leaking accumulator lines or fittings.	
	Incorrect setting of accumulator gas charge.	Check accumulator gas charge.
	Line to accumulator plugged.	Replace line.
Accumulator starts to charge but does not reach high limit	Defective pressure switch.	Replace switch.
	No oil or low oil level in tank.	Check oil level.
	Pump worn or inoperative and not delivering full flow or pressure.	Check pump.
Accumulator charging time too long	Inoperative charging valve.	Replace charging valve.
	No oil or low oil level in tank.	Check oil level.
	Relief valve setting too low.	Check valve setting.
	Pump worn or inoperative and not delivering full flow or pressure.	Check pump.
Accumulator fails to start charging	Inoperative charging valve.	Replace charging valve.
	No oil or low oil level in tank.	Check oil level.
	Worn or inoperative pump.	Check pump pressure and flow.
	Inoperative relief valve.	Check relief valve settings.
	Air in accumulator line.	Bleed accumulator line.

SERVICE CHECKS FOR BRAKE SYSTEM

SYMPTOM	PROBABLE CAUSE	REMEDY
Very rapid cycling of charging valve	Incorrect setting of accumulator gas charge.	Check accumulator gas charge.
	Inoperative charging valve.	Replace charging valve.
Lack of adequate flow through valve	Inoperative pump.	Check pump pressure and delivery.
	Blocked lines.	Replace lines.
	Inoperative charging valve.	Replace charging valve.
Accumulator charges continously	Bad solenoid valve.	Check voltage at solenoid valve in manifold block. If voltage is present, replace solenoid valve.
	Defective or disconnected wire.	If voltage is not present at solenoid, check continuity with mico switch and replace wires.
	Defective pressure switch	If mico switch is not sending a signal to the solenoid valve, replace switch.

ACCUMULATORS

The type of accumulators that the machines use are Parker piston type. Some useful information follows:

•Pre charge - 750 psi. of Nitrogen

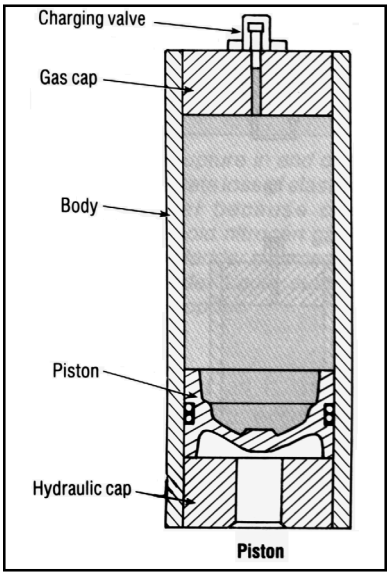
Failure prevention

Accumulator failure generally is defined as its inability to accept and exhaust a specified amount of fluid when operating over a specific system pressure range. Failure often results from an unwanted loss or gain of precharge pressure.

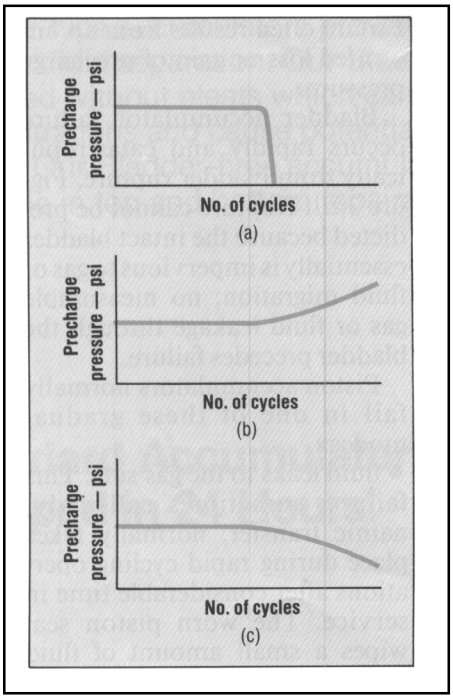
Piston accumulators normally fail in one of these gradual modes:

• Fluid leaks to the gas side. This failure, sometimes called dynamic transfer, normally takes place during rapid cycling operations after considerable time in service. The worn piston seal wipes a small amount of fluid into the gas side with each stroke; as the gas side slowly fills with fluid, precharge pressure rises, and the accumulator stores and exhausts decreasing amounts of fluid. The accumulator totally fails when precharge pressure equals maximum hydraulic system pressure. At that point, the accumulator will accept no fluid. Because the rise in precharge pressure can be measured, failure can be predicted and repairs made before total failure occurs, and gas escapes.

• Precharge usually is lost as gas slowly bypasses deteriorated piston seals. Seal deterioration occurs from the wear of millions of cycles, from fluid contamination or from a combination of the two. Gas also can directly vent through a defective gas valve core or end-cap O-ring. Less precharge pressure forces less fluid into the system. Because this gradual decrease in precharge pressure also can be measured, repairs again can be made before total failure.



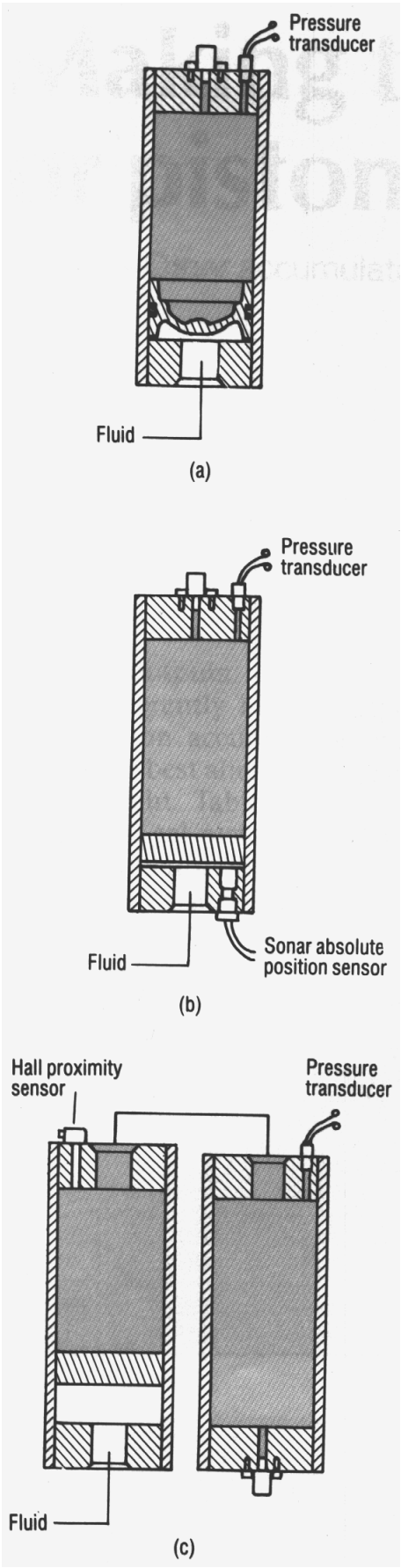
A TYPICAL PISTON TYPE ACCUMULATOR



A bladder type failure is shown in (a). As fluid leaks past piston (b), gas side of piston accumulator fills with fluid to increase precharge pressure. If precharge gas leaks past piston or vents through gas valve, (c), accumulator gradually forces less fluid into system for lower efficiency.

FAILURE PREDICTION

Several methods can be used to monitor the precharge pressure of piston accumulators:
•with the hydraulic system shut down. A pressure transducer or gauge located in the gas-end cap,(a), indicates the true precharge pressure after a working hydraulic system has cooled and the accumulator does not contain fluid
•with the hydraulic system operating. On request, accumulator manufacturers will install a piston-position sensor in an accumulator's hydraulic-end cap, (b). This sensor can be connected to a number of electronics packages. With an accurate precharge and after enough system operation for thermal stability, the electronics can be calibrated to provide continuous readout of precharge pressure that corresponds accurately to the true precharge, and
•another alternative. In applications where an accumulator is coupled to a gas bottle, a Hall Effect sensor can be installed in the accumulator gas-end cap, (c), to detect when the piston comes within 0.040 inches of the cap. This warning indicates that precharge pressure has dropped and the system should be shut down and checked.



SETUP AND MAINTENANCE

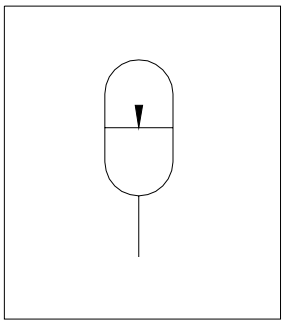
Precharge Technique
The fluid side should be empty during precharging so that gas-side volume is at a maximum. Little damage, if any, can take place during precharging.

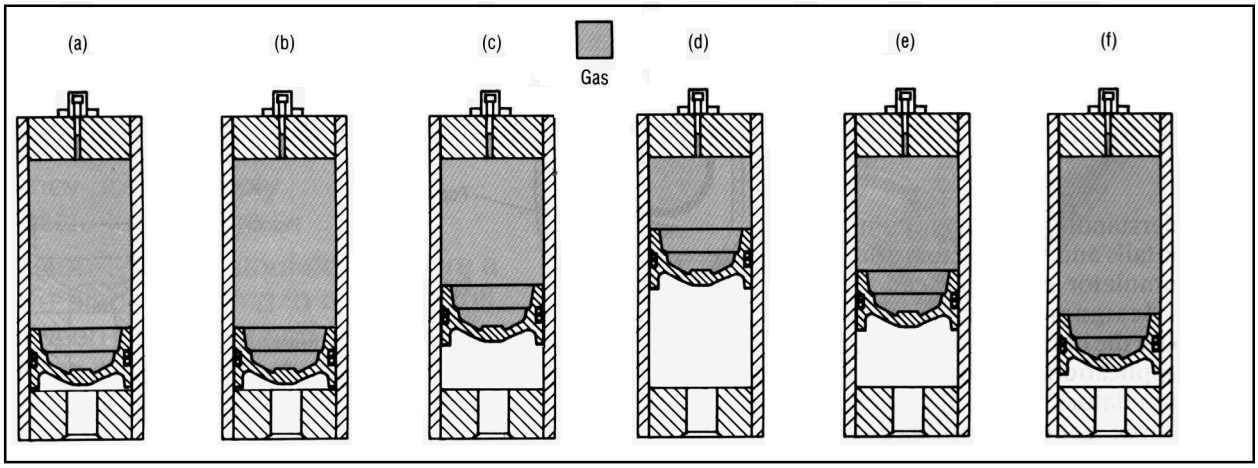
Precharge pressure
Excessively high precharge.
Excessive precharge pressure or a reduction in the minimum system pressure without a corresponding reduction in precharge pressure may cause operating problems or damage.
With excessive precharge pressure, a piston accumulator will cycle between stages

(e) and (b), and the piston will range to close to the hydraulic-end cap. The piston could bottom at minimum system pressure to reduce output and eventually cause damage to the piston and the piston seal. The bottoming of the piston often can be heard; the sound serves as a warning of impending problems.

Excessively low precharge.
Excessively low precharge pressure or an increase in system pressure without a compensating increase in precharge pressure also can cause operating problems and may promote accumulator damage. With no precharge in a piston accumulator, the piston likely will be driven into the gas-end cap and probably will remain there. Most likely, no damage will occur with this single contact.

The schematic representation of an accumulator is shown here:





PRE-CHARGING

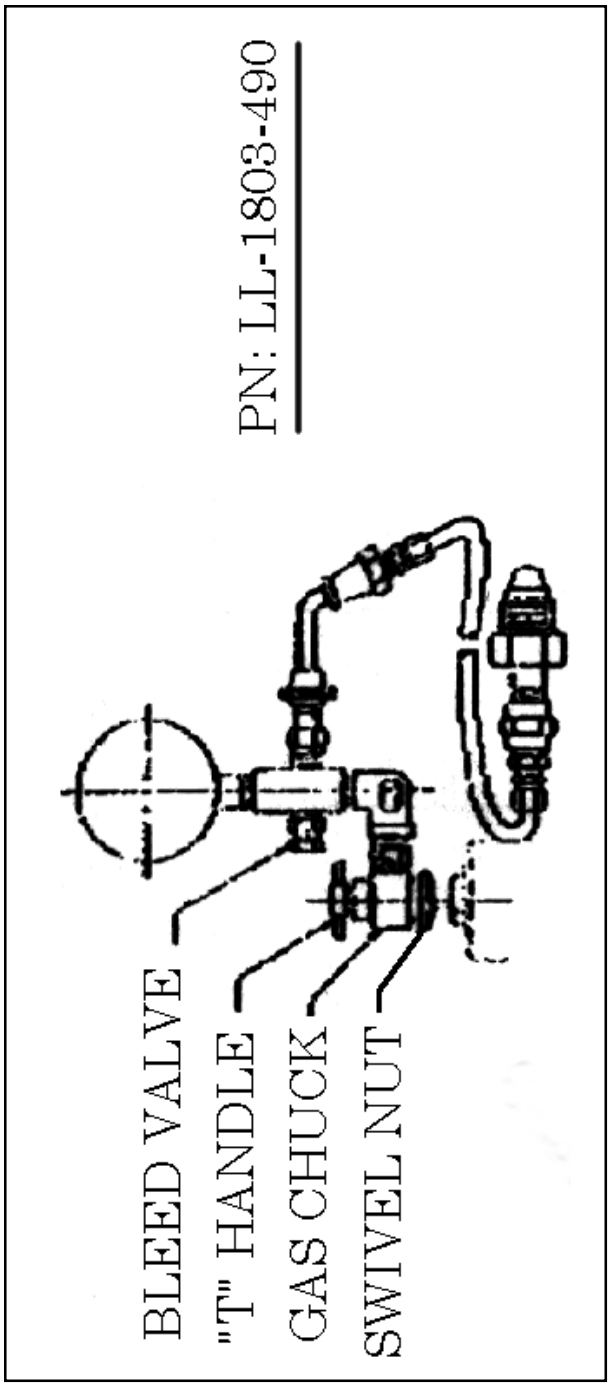
Use an inert gas such as nitrogen for precharging accumulators.

If water pumped nitrogen is not available, oil-pumped nitrogen may be used. C.G.A. standards: Nitrogen gas bottles for water pumped nitrogen has a right-hand valve thread which requires charging and gauging assembly LL-1803-490 for units up to 3000 psi.

If equipment other than the above listed is used, make sure it is compatible with the gas valve assembly. Nitrogen source and all components must be rated for a pressure at least as high as the nitrogen source. It is strongly recommended that the nitrogen bottle used have a high pressure regulator.

Make sure nitrogen supply is shut off. Attach hose to nitrogen bottle.

(A) Remove gas valve guard and gas valve cap.
(B) Back gas chuck “T' handle all the way out (counter clockwise) before attaching charging assembly to accumulator gas valve.
(C) Close bleed valve.
(D) Making sure not to loop or twist the hose attach swivel nut to gas valve and tighten (10-15 in. lb.) (11.5-17 cm kg).
(E) Turn gas chuck "T" handle all the way down. This will depress core in gas valve.
(F) Crack open nitrogen bottle valve and slowly fill accumulator. Shut off when gauge indicates desired precharge.
(G) Let the precharge set for 10 to 15 minutes. This will allow the gas temperature to stabilize. If the desired precharge is exceeded, close nitrogen bottle valve, then slowly open bleeed valve. Do not reduce precharge by depressing valve core with a foreign object. High pressure may rupture rubber valve seat.
(H) When finished precharging accumulator, turn “T” handle all the way out on gas chuck, then open bleed valve.
(I) Hold gas valve to keep from turning, loosen swivel nut, remove assembly.
(J) Replace gas valve cap (10-15 in. lbs.) (11.5-17 cm kg) and valve guard. (Gas cap serves as a secondary seal.)



Repair Kits (see Parts Book) are available for all accumulator models. When ordering repair kits, state complete model number from nameplate. Also specify fluid and temperature at which used.

Occasional replacement of v-o-ring seal on the piston is generally the only maintenance required. Replacement of other seals on end caps and gas valve is recommended (see Kit Numbers).

Periodic checking of precharge pressure will detect whether v-o-ring wear is sufficient to begin reducing sealing performance. If precharge is low, also check for gas valve and/or end seal leakage. Allowing for temperature difference, if any, from time of its pressure checking, precharge pressure will rise if oil gathers in the gas side and will fall if gas leaks into the oil side or out past gas end seals. It is suggested that a check be made a week after installation, and thereafter once a month.

Precharge Checking Procedure

Using appropriate valve in the hydraulic system, discharge all oil from accumulator and allow piston to bottom against hydraulic end cap.

For the accumulator used on the forklift, use gauging assembly, Part # LL-1803-490.

For accumulators having gas valve:

(1) Remove gas valve guard and cap.

(2) Back gas check “T” handle all the way out (counter clockwise) before attaching charging assembly to accumulator gas valve.

3) Close bleed valve.

(4) Attach swivel nut to gas valve and tighten (10-15 in. lb.) (11.5-17 cm kg).

(5) Turn gas chuck “T” handle all the way down. This will depress core in gas valve and check pressure.

(6) To remove gauging assembly turn “T” handle all the way out on gas check (Figure 1), then open bleed valve.

(7) Hold gas valve from turning, loosen swivel nut, remove assembly.

(8) Replace gas valve cap (10-15 in. lbs.) (11.5-17 cm kg) and valve guard.

Remove from Hydraulic System

Shut equipment down and make certain that hydraulic pressure at the accumulator is at zero. At this point the piston will be bottomed at the hydraulic end.

For accumulators having gas valve, attach gauging assembly, then follow steps 1 through 5. Open bleed valve until all gas precharge is relieved from accumulator. Next, remove gauging assembly and gas valve.

Remove accumulator from hydraulic system. Threaded holes in hydraulic cap may be used as a means of attachment for lifting, or use a sling around the body.

Disassembly of Accumulator

Lay the accumulator horizontally and hold down with a strap wrench or in a vise. Some accumulators may have both end caps threaded into the body and some units may only have the gas cap threaded into the body. IN BOTH CASES ALWAYS REMOVE THE GAS CAP FIRST (end cap which contained gas valve). To remove cap or caps, install three (3) pins into the holes in the cap, then, using a long bar working against the pins, unthread the cap from the body. Remove o-rings and back-up rings from end cap.

Remove piston by pushing from hydraulic end with a bar. NEVER TRY TO REMOVE PISTON BY APPLYING COMPRESSED AIR AT OPPOSITE END. To remove v-o-ring from piston, lift seal with small smooth screw driver or similar tool, moving the tool around the piston several times while using the other hand to work ring off the piston.

Cleaning

Thoroughly clean metal parts in solvent and dry with compressed air. Clean bore of body with a clean, lint-free cloth soaked in clean solvent. Bore must be clean of any visible particles or particles detectable to touch.

Inspection

Inspect piston for cracks, burrs around o-ring grooves, or damage. Examine body bore, using a light, for scratches or scoring. Inspect end caps for damaged threads of burrs on o-ring grooves.

Repair and Replacement

Minor nicks, scratches or light scoring of the body bore can be removed by using crocus cloth. Dress bore until all apparent imperfections have been removed. Replace teflon wear rings, v-o-rings, o-rings and their respective back up washers if the original assembly contained them.

Reassembly

Coat all internal parts with clean hydraulic fluid before reassembly.

With new v-o-ring and Teflon rings on piston, install piston, hollow side toward gas end, in bore of body. Do not let v-o-ring drag on threads. Piston must go into bore exactly square and very slowly. (V-o-ring will compress as it rides up the chamfer if done slowly, but may be damaged if forced quickly.) Piston will fit snug. Use hammer and wood block to tap piston into place until all of piston is 2 inches below beginning of honed bore. Keep force against piston while tapping v-o-ring through the bore chamfer, otherwise piston will bounce back, damaging the o-ring. Cover port opening to keep dirt out.

Install new back-up ring first, then a new o-ring on threaded end cap or caps and install into body bore. Care should be exercised not to drag o-ring over threads. End cap will stop against chamfer leading into honed bore (extreme tightness not required, o-ring sealing is not dependent upon cap tightness). Cap should be flush with or above the end of accumulator body within 1/32” to 3/32”.

Install gas valve after replacing the o-ring.

Remount accumulator and connect to hydraulic system. Precharge accumulator (where space is a problem it may be necessary to precharge accumulator before connecting it to the hydraulic system).

Accumulator Charging Valve

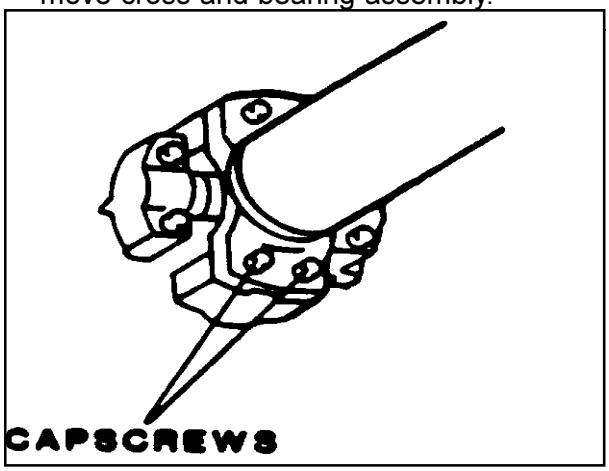
The accumulator charging valve is nothing more than a solenoid valve that is controlled by a Hi-Low limit switch. This solenoid valve directs the oil to the accumulator when the charged pressure drops below 1000psi, and returns the load sense signal back to tank. Under normal operating conditions, where the accumulator pressure is above 1000psi, system pressure is constantly applied to the accumulator and to the load sense signal. This allows the accumulator to stay charged during normal operation.

ACCUMULATOR TROUBLESHOOTING

SYMPTOM	PROBABLE CAUSE	REMEDY
Accumulator charges during engine cranking	Open diode in harness	Verify 12VDC present between pin A (wht +) and pin B (blk -) on S1 solenoid valve on charging manifold. If absent, replace diode.
Accumulator does not charge	Charging pressure switch shorted	Unplug charging pressure switch. If charging begins, replace pressure switch.
	Defective solenoid	Replace solenoid
Accumulator charges at all times (pressure over 1000psi)	Defective fuse.	Replace fuse #6
	Defective pressure switch-open	Unplug pressure switch and and jump harness side plug pin A to B. If charging stops, replace pressure switch.
	Open diode in harness	Verify 12 VDC present between pin A (org +) and ground at charging pressure switch. If absent, replace diode.
	Defective solenoid coil.	Verify coil resistance @ 9.2 ohms. If open or high, replace coil.
	Defective solenoid.	If electrical check ok, replace solenoid.
Lo brake oil light does not go out	Defective lo brake oil pressure switch	Unplug pressure switch, if light goes out, replace switch.
Lo brake oil light does not light (pressure below 650psi)	Defective bulb on lamp assy	Replace bulb on lamp assy
	Defective lo brake oil pressure switch	Jump pin A (brn +) to pin B (blk -) on lo brake pressure switch. If light glows, replace pressure switch.

DISASSEMBLY OF DRIVESHAFT

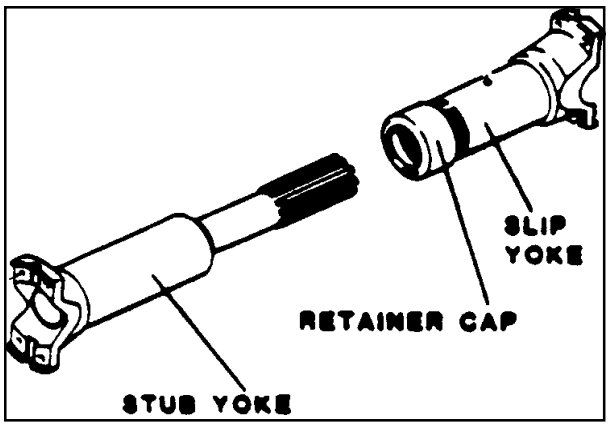
1. Remove the (4) capscrews and (4) lockwashers which secure the cross and bearing assembly to the stub yoke. Remove cross and bearing assembly.



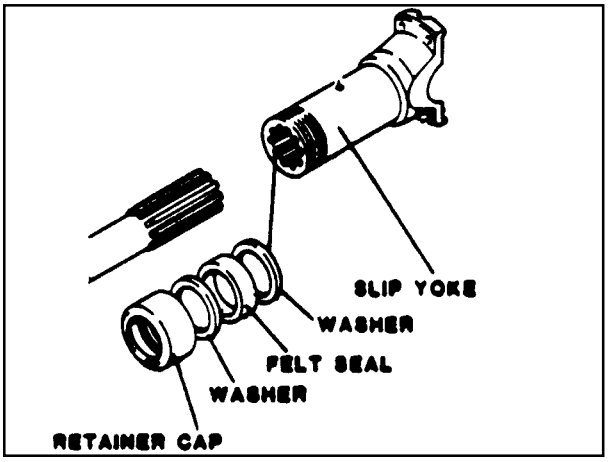
2. Remove the (4) capscrews and (4) lockwashers which secure the other cross and bearing assembly to the slip yoke. Remove cross and bearing assembly.

3. Unscrew grease fittings from cross and bearing assemblies.

4. Separate the driveshaft assembly by loosening the retainer cap and sliding the slip yoke from the stub yoke. Use caution to prevent damaging the splines. Unscrew grease fitting from slip yoke.



5. Remove retainer cap, (2) washers and felt seal from end of slip yoke.



RETAINER CAP AND SEALS

6. Inspect stub yoke and slip yoke splines for excessive wear. Check slip yoke and retainer cap for damaged threads.

7. Inspect cross and bearing for side play. If worn, replace complete cross and bearing assembly.

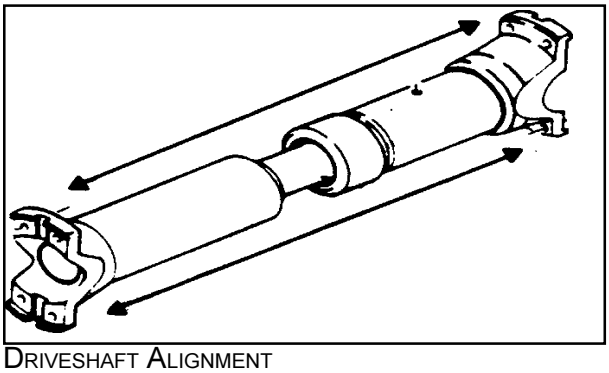
NOTE: OPPOSITE BEARINGS ARE HELD IN PLACE ON THE CROSS BY A WELD WIRE. CUTTING THIS WIRE WILL ALLOW REMOVAL OF BEARINGS FROM CROSS. HOWEVER, IF CROSS END BEARINGS ARE REPLACED AS AN ASSEMBLY, CUTTING IS UNNECESSARY.

ASSEMLY OF DRIVESHAFT

1. Replace the (2) washers, felt seal and retainer cap on end of slip yoke. (Felt seal, goes between the washers.)

2. Install grease fitting in slip yoke.

3. Slide slip yoke and stub yoke together, being certain to properly engage splines. Make sure that yokes on both ends of the driveshaft are in the same plane. This alignment is necessary for correct timing.

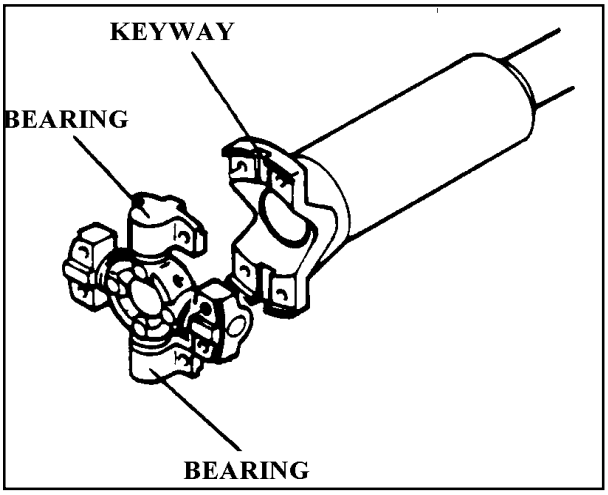


DRIVESHAFT ALIGNMENT

4. Tighten retainer cap on slip yoke.

5. Install grease fittings in cross and bearing assemblies.

6. Position a cross and bearing assembly on either end of driveshaft. Insert opposite bearings of cross into keyed portion of driveshaft yoke.



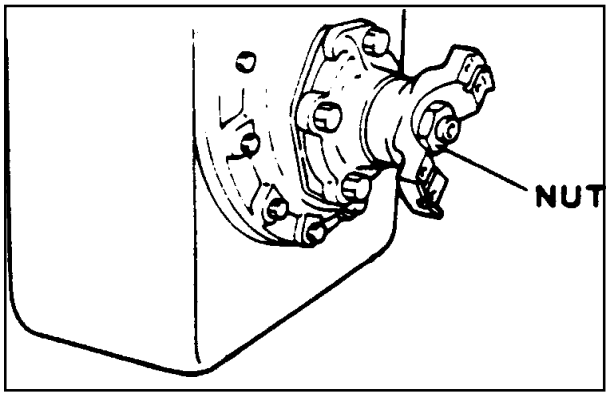
INSERT CROSS BEARINGS INTO YOKE KEYWAYS

Clamp opposite bearings with a “C” clamp to compress seals and seat each bearing into its keyway. DO NOT INSTALL BEARING CAPSCREWS UNTIL BEARINGS ARE PROPERLY SEATED.

7. Secure opposite bearings of cross to driveshaft yoke with the (4) capscrews and (4) lockwashers. Remove “C” clamp.

8. Repeat steps 6 and 7 for other cross and bearing assembly.

9. Check tightness of transmission yoke retaining nuts.



TRANSMISSION YOKE RETAINING NUT

INSTALLATION OF DRIVESHAFT

⚠WARNING!

HEAVY COMPONENTS! BEFORE INSTALLING DRIVESHAFT, CHECK ITS WEIGHT AND MAKE PROVISIONS FOR ATTACHING AND LIFTING. USE A HOIST CAPABLE OF SUPPORTING THE WEIGHT. A SLIPPING OR FALLING COMPONENT MAY RESULT IN SERIOUS INJURY OR DEATH.

1. Secure a suitable lifting strap from hoist to driveshaft. Lift the driveshaft into position between transmission and axle.

2. Bring one end of driveshaft up against drive yoke on axle or transmission. Insert opposite bearings of cross into keyed portion of drive yoke.

Clamp opposite bearings with a ”C” clamp to compress seals and seat each bearing into its keyway. DO NOT INSTALL BEARING CAPSCREWS UNTIL BEARINGS ARE PROPERLY SEATED.

3. Secure opposite bearings of cross to drive yoke with the (4) capscrews and (4) lockwashers. Remove clamp.

4. Repeat steps 2 and 3 for other end of driveshaft.

5. Remove block and jack from axle.

6. Lubricate the driveshaft and cross and bearing assemblies with the recommended lubricant specified.

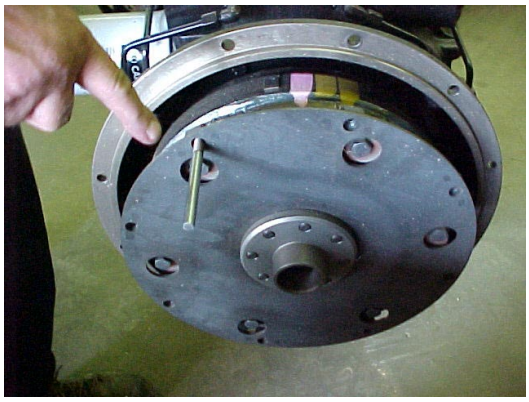
Driveshaft Troubleshooting

SYMPTOM	PROBABLE CAUSE	REMEDY
Noise	Lack of lubricant.	Check bearing cap grease seals for wear. Replace if worn. Lubricate with correct grade of grease specified.
	Driveshaft assembly is out of balance.	Check for proper alignment.
		Clean dirt from driveshaft.
		Check for missing balance weights.
	Backlash due to worn cross or bearing.	Replace cross and bearing assembly as a complete unit.
	Off center rotation due to worn slip joint.	Replace slip joint or driveshaft assembly.
Vibration	Yokes are not in line.	Check for proper driveshaft alignment. (See Assembly of Driveshaft'.)
	Driveshaft out of balance.	Replace driveshaft assembly.
	Driveshaft sprung from contact with obstruction.	Replace driveshaft assembly.
	Excessive run out or distorted yokes.	Disassemble and correct or replace damaged parts.
	Loose flange nut on transmission or differential flange.	Tighten nut and check splines. If worn, replace driveshaft assembly.
	Parking brake drum warped.	Replace parking brake.
	Off center rotation due to worn slip joint.	Replace slip joint or driveshaft assembly.

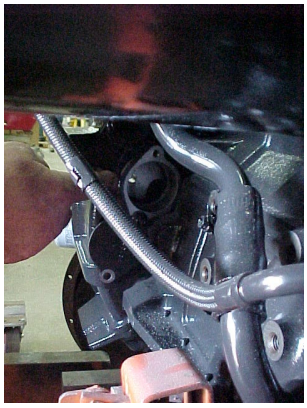
NOTES

Engine/Transmission Assembly

1. Install a dowel pin onto the torque converter for aligning it to the flywheel.

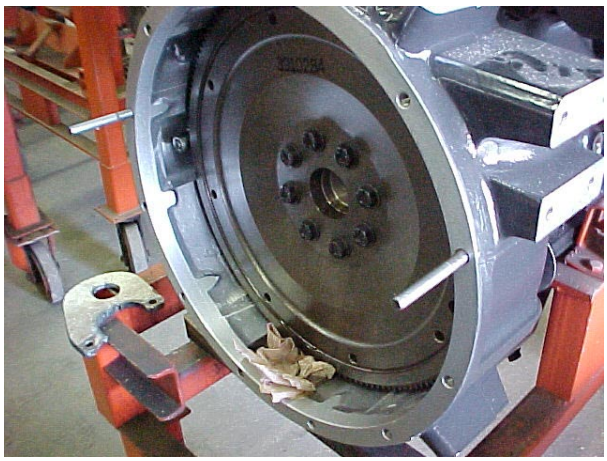


Dowel on Transmission



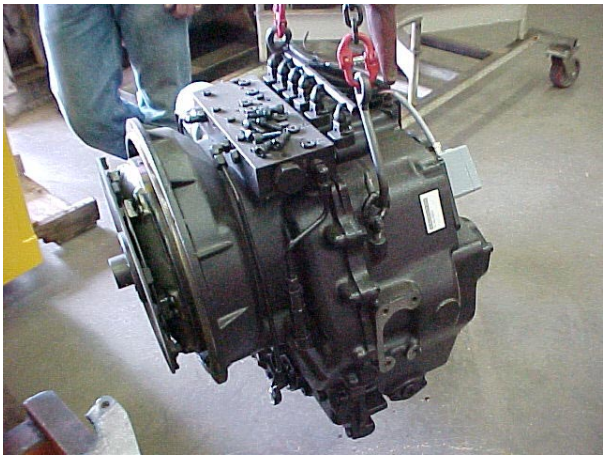
Alignment Location on Engine

2. Install two more dowels into the bell housing, on the engine, for aligning the transmission housing with the engine housing.



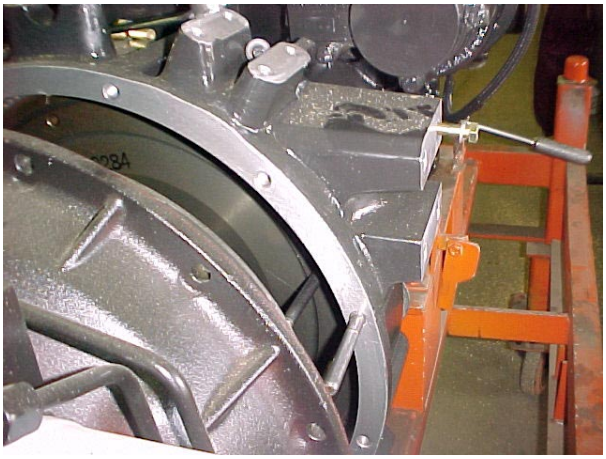
Dowels on Engine

3. Lift the transmission with two eye bolts attached on the side mounting holes of the transmission housing.

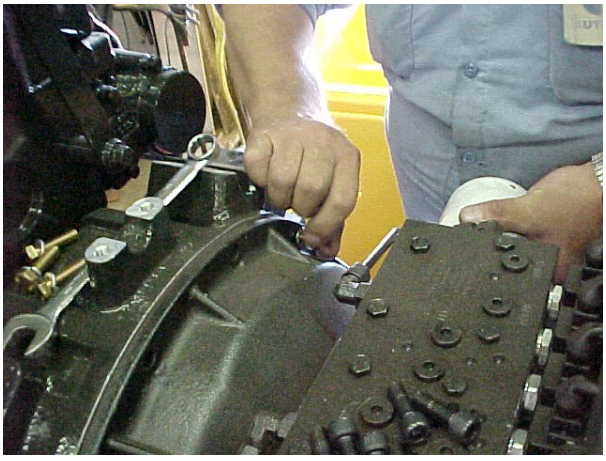


Lifting Transmission

4. Using the aligning dowels, move the transmission up against the engine and start all of the mounting bolts. While the transmission is still being supported by the lift, tighten all of the mounting bolts.

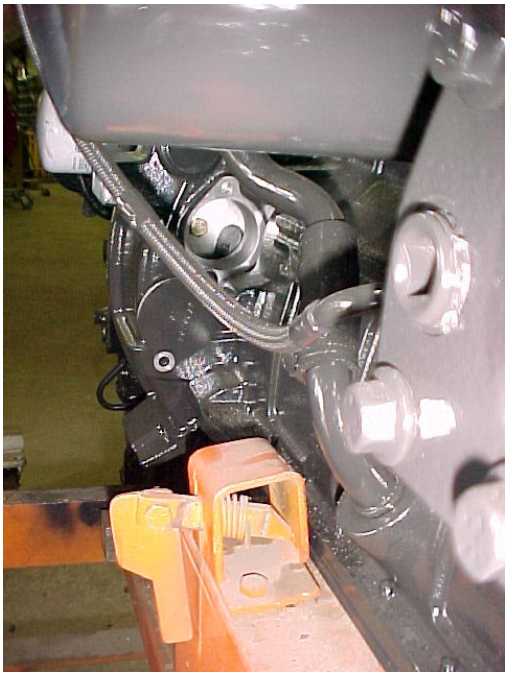


Aligning Transmission



Starting Bolts

5. Open the access cover on the engine to insert and tighten the bolts, to 35 Ft-Lbs, that mate the flywheel and the transmission torque converter. Rotate the engine to each successive threaded hole until all of the (8) eight bolts are secured.



6. Remove the dowels from the housing and install the remaining bolts to secure the transmission to the engine.

DISASSEMBLY

To disassemble, do the previous steps in reverse order.

INDEPTH SERVICE

Please refer to the Carraro TLB2 manual that was shipped with your machine for further disassembly and troubleshooting.

TRANSMISSION TROUBLESHOOTING

SYMPTOM	PROBABLE CAUSE	REMEDY
Transmission slips	Low transmission oil level	Fill transmission with proper oil to proper level
	Worn clutches	See authorized dealer
	Contaminated transmission	Drain transmission, filter element, and refill with clean oil. If problem persists, see authorized dealer
Transmission will not change into selected gear	Linkage loose or out of adjustment	Connect and/or adjust linkage
	Internal damage to transmission valve	See authorized dealer for service
	Low transmission oil level	Fill transmission with proper oil to proper level

CARRARO TRANSMISSION CONTROL TROUBLESHOOTING

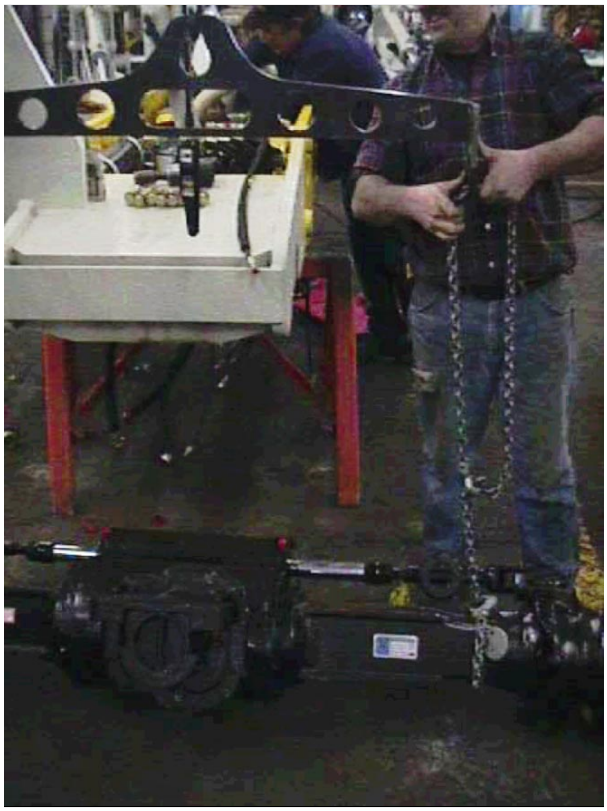
SYMPTOM	PROBABLE CAUSE	REMEDY
No 1st gear-same procedure for 2nd, 3rd and 4th)	Defective shifter	Verify 12 VDC available between pin 1 and pin 2 of 1st gear solenoid plug. If absent, replace shifter.
	Defective solenoid coil	Verify coil resistance 8 ohms. If open or high, replace coil.
	Defective solenoid	If electric checks ok, replace solenoid.

SYMPTOM	PROBABLE CAUSE	REMEDY
No shifter power. Machine does NOT start.	Defective fuse.	Verify 12 VDC available to pin 1 (blu) on shifter plug. If none, replace fuse #7.
No FWD engage No REV engage	Defective shifter	Verify 12 VDC available to FWD/REV control module plug on Pur/Wht wire in FWD. If not present, replace shifter.
.		Verify 12 VDC available to FWD/REV control module plug on Org/Wht wire in REV. If not present, replace shifter.
	Defective FWD/REV control module. NOTE: OUTPUT OF MODULE IS APPROX. 6VDC	Verify approx. 6 VDC available to FWD solenoid plug between pin 1 (grn/yel) and pin 2 (blk) on FWD solenoid. If not present, replace FWD/REV Control module.
		Verify approx. 6 VDC available to REV solenoid plug between pin 1 (gry) and pin 2 (wht) on REV solenoid. If not present, replace FWD/REV Control module.
	Defective wire - no power to control module	Verify 12 VDC available to FWD/REV control module plug between blu (+) and brn (-). If absent, repair wire defect.
	Defective solenoid coil.	Verify coil resistance 3.2 ohms of affected coil. If open or high, replace coil.
		NOTE: MAXIMUM FWD/REV COIL VOLTAGE IS 6 VDC - DO NOT PLACE 12 VDC ACROSS COIL TERMINALS TO PREVENT BURNOUT.
	Defective solenoid.	If electric checks ok, replace solenoid.
	Defective CCO circuit	See CCO troubleshoot.

NOTES

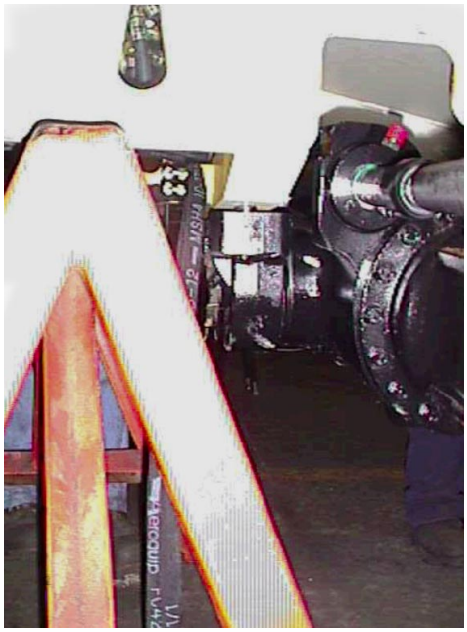
Axle Installation

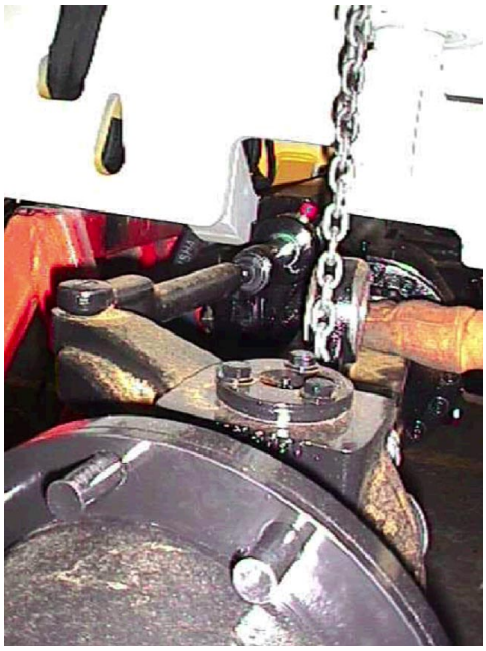
1. Using some type of overhead sling, lift the front axle up near the mounts on the frame. Be careful to align the (4) four dowels on the axle with the holes on the frame mounts. If the dowels do not line up, check the rubber gasket between the axle housing and the trunnions (where the dowels are attached).



ATTACHING SLING AND CHAINS LIFTING AXLE

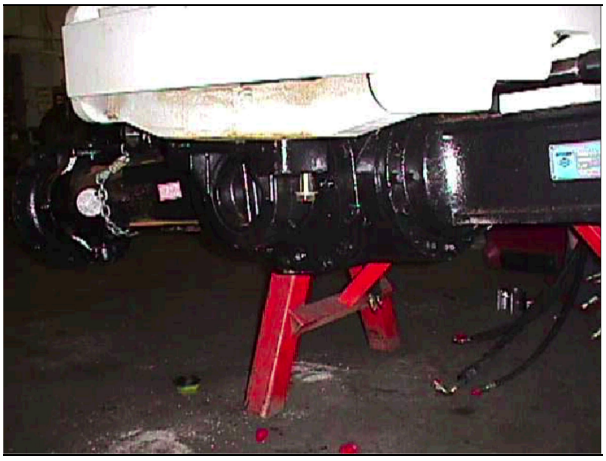
ALIGNING AXLE





ALIGNING AXLE

2. Once the axle is set in place, attach it with the (4) four capscrews that secure it to the frame. Apply a light coating of thread lock, snug them, and then torque them to 360-470 ft-lbs. (wet) with a torque wrench.



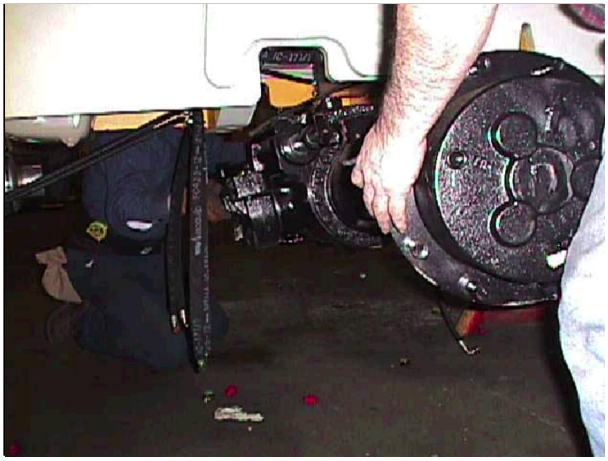
STARTING BOLTS

TIGHTENING BOLTS

TORQUING BOLTS

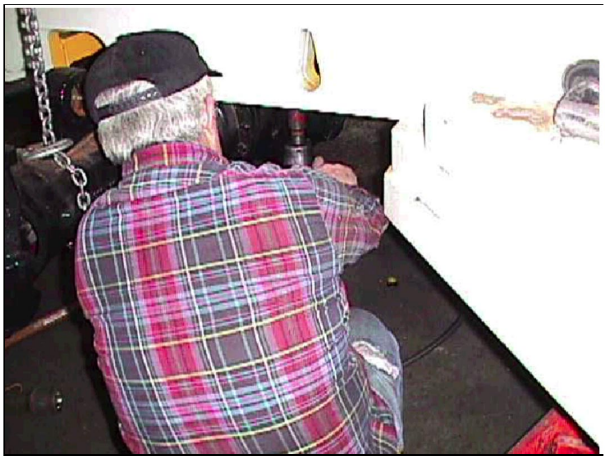
3. Follow the same steps to attach the rear axle, and torque them to the same 300 ft-lbs. (wet), being sure to apply a thin coating of thread lock prior to installing the capscrews.

MOVING REAR AXLE INTO PLACE

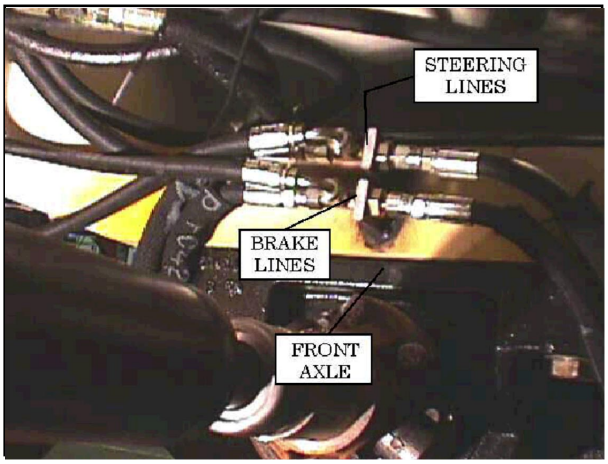


SECURING AXLE

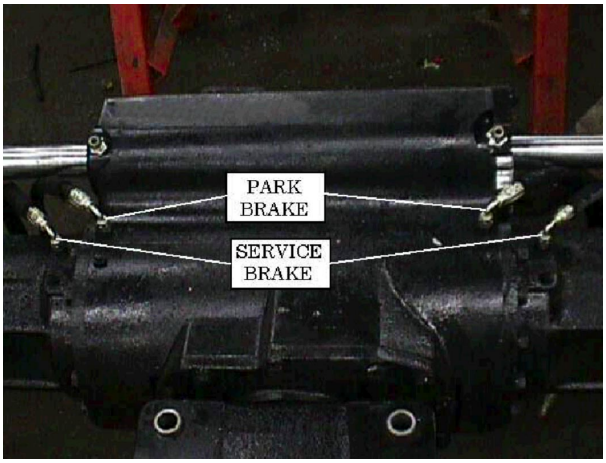
ATTACHING SLING AND CHAINS
LIFTING AXLE



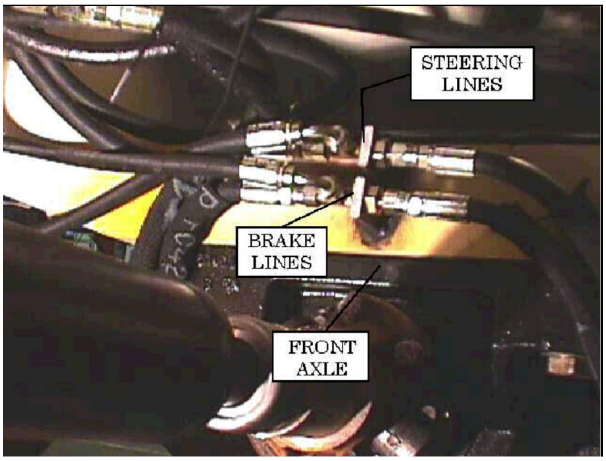
4. When the axles are attached and secured, connect the brake and steering hydraulic lines.



FRONT AXLE BRAKE AND STEERING LINES



STEERING AND BRAKE LINE FITTINGS



REAR AXLE BRAKE AND STEERING LINES

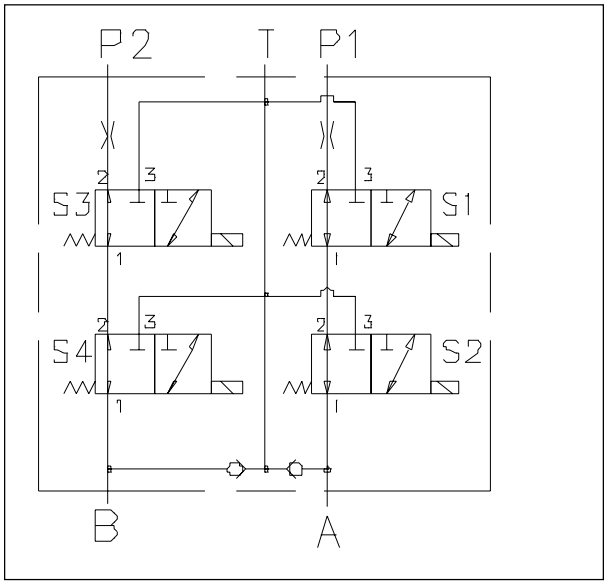
5. Lastly, put the tires back onto the axles.

AXLE REMOVAL

For the removal steps, just follow the installation steps in the reverse order.

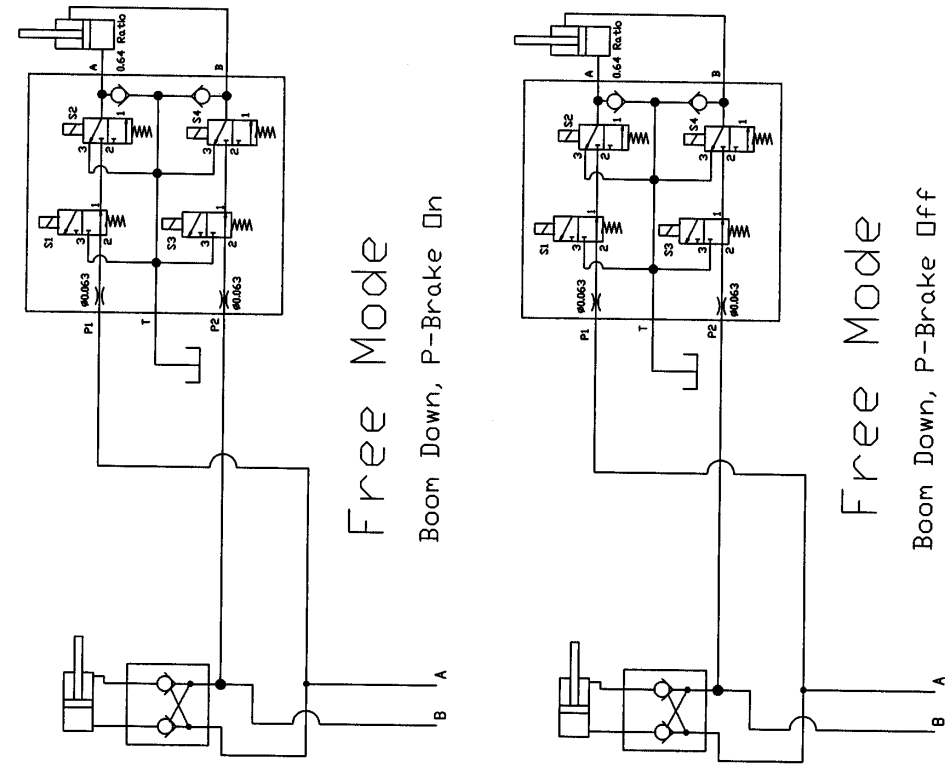
INDEPTH SERVICE

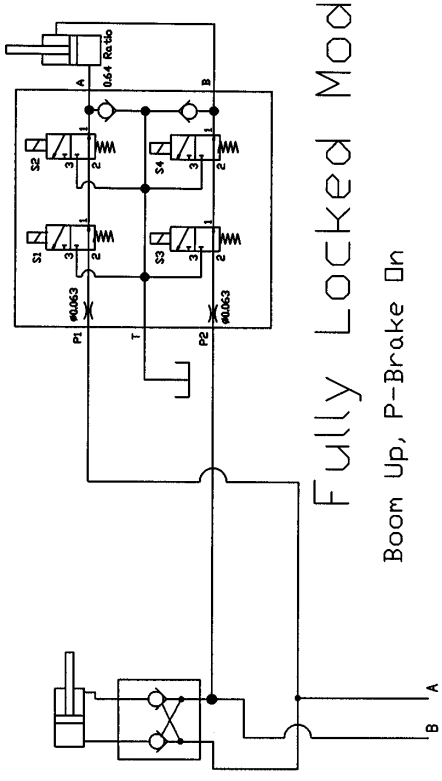
Please refer to the correct Carraro axle manual that was shipped with your machine for further disassembly and troubleshooting.

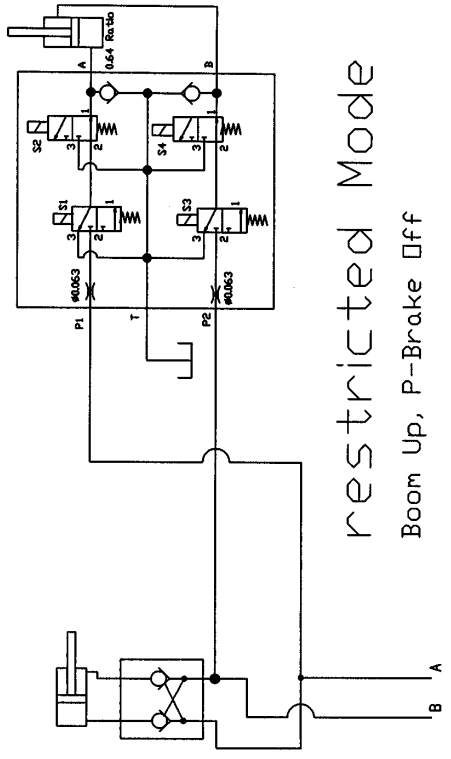


REAR AXLE STABILIZATION MANIFOLD HYDRAULIC SCHEMATIC SYMBOL

REAR AXLE STABILIZATION MODES







REAR AXLE STABILIZATION TROUBLESHOOTING

SYMPTOM	PROBABLE CAUSE	REMEDY
Rear axle not free with boom down, park brake switch OFF, 'lock' light OFF, 'restrict' light OFF	Defective oscillation limit fuse.	Verify 12 VDC available to boom limit switch plug pin A. If absent, replace fuse #6.
	Defective oscillation limit relay.	Temporarily replace relay #6 with relay #7. If axle releases, replace relay #6.
	Defective solenoid (s) coil	Verify solenoid continuity resistance 8 ohms on S2 & S4 valves of oscillation manifold block. If either or both open or high resistance, replace solenoid (s).
	Defective solenoids	Replace solenoids.
Rear axle in restricted mode, boom down, park brake OFF, Restrict light ON.	Boom limit switch mis-adjusted.	Readjust switch to open @ 25° boom UP.
Rear axle in lock mode, Park brake ON, lock light ON	Defective boom limit switch	Jump pin A to pin B of boom limit switch harness plug. If axle goes to free mode, replace and readjust boom limit switch.
	Defective osc. limit relay.	Temporarily replace relay #6 with relay #7. If axle release and mode lights go out, replace relay #6.
Rear axle goes from free to lock @ 25° boom UP, lock light ON , park brake OFF	Defective osc. lock relay	Temporarily replace relay #3 with relay #7. If axle reverts to limit mode, limit light ON, replace relay #3.
Rear axle does not lock when park brake switch ON, boom above 25° in restrict mode, restrict light ON	Defective osc. lock relay	Temporarily replace relay #3 with relay #7. If axle revers to lock mode,lock light ON, replace relay #3.
Rear axle does not go to restrict mode, restrict light ON, boom above 25°	Defective solenoid coils	Verify S1 & S3 coil continuity resistance of 8 ohms. If open or high resistance, replace coil (s).

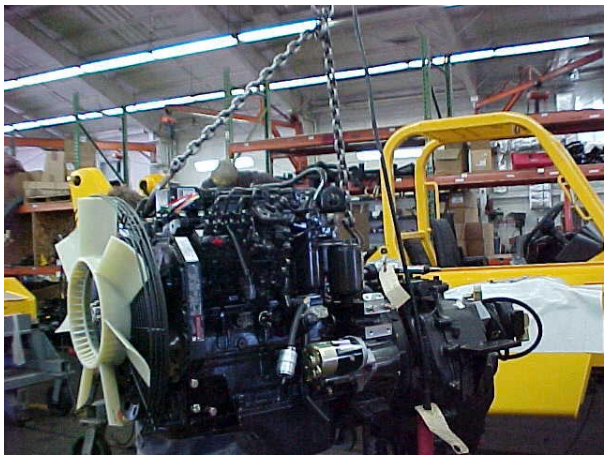
SYMPTOM	PROBABLE CAUSE	REMEDY
Restrict light does not light in restrict mode, axle works properly.	Defective bulb or lamp assembly	Replace bulb or lamp assy.
Lock light does not light in lock mode, axle works properly	Defective bulb or lamp assembly	Replace bulb or lamp assy.
	Defective lock relay.	Temporarily replace relay #3 with relay #7. If light glows, replace relay #3.

NOTES

NOTES

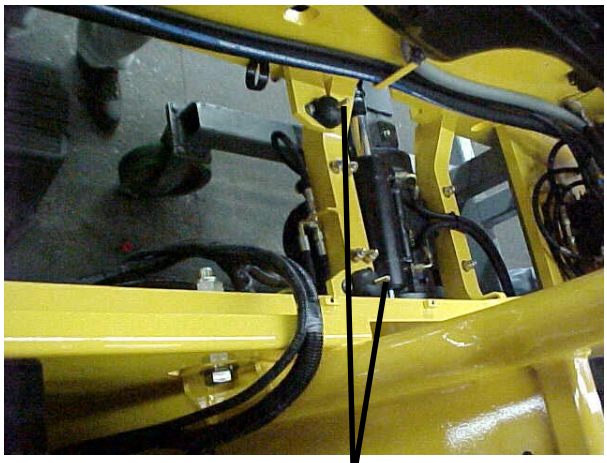
Engine Installation

1. Attach a chain with hooks to two lifting points on the engine and transmission, and lift them over the frame.



Engine on hoist

2. Lower engine and transmission down onto the mounts that are attached to the frame.



Mounts

Torque Values (Ft-Lb):	Dry	Lubed
M12x1.75	93	70
1/2 -UNC	110	80

Note: 1/2 -UNC through top of dome mount should not exceed 50 Ft-Lb.

3. Align the mounts and place the bolts through the holes. Attach the washer and nuts , but wait to tighten until after the radiator has been installed.

Engine/Transmission in Place

6. When the engine and transmission are in place, install the radiator.

Radiator Installation

1. Attach a chain to the upper most bolts that secure the mounts to the radiator.

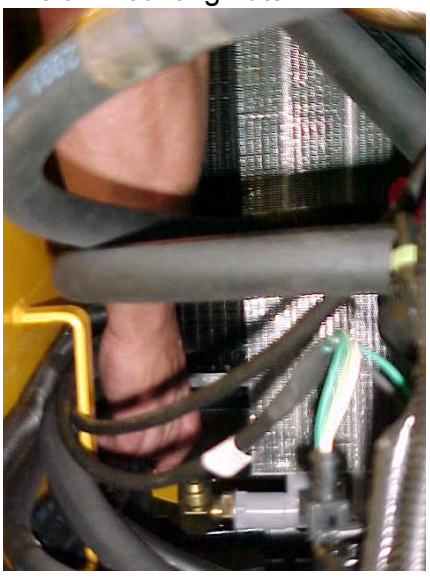
2. Move the radiator over the rear portion of the frame and carefully lower it down into place

LOWERING RADIATOR

3. When the radiator is aligned over the mounting holes in the frame, start the four mounting bolts.

IMPORTANT! Be sure that the radiator is as low in the mounts as possible. This is to prevent the lift cylinders from hitting the top of the radiator when the boom is completely lowered. If the radiator will not set all of the way down, GENTLY tap it down with a dead blow hammer, or the heel of your hand.

4. Secure all (4) four of the radiator mounting bolts and also tighten the engine/transmission mounting nuts.



INSTALLING RIGHT RADIATOR MOUNT

INSTALLING LEFT RADIATOR MOUNT

5. Once the radiator is secured, attach the fan guard with (4) four lockwashers and (4) nuts to the studs that are on the shroud.

6. When the fan guard is mounted, connect the upper and lower radiator hoses, and also the oil cooler lines for the transmission.

7. Fill the radiator up with a 50-50 mixture of antifreeze and water. IMPORTANT! When finished connecting engine, run engine until at operating temperature and check coolant level. Fill as needed.

8. Once the radiator is installed, reconnect the throttle linkage mount, and attach the throttle linkage to the fuel pump. Also, reconnect the fuel supply line to the fuel pump.

9. Reconnect the electrical wiring and plugs to their previous locations. **NOTE:** All electrical connections should be match-marked during disassembly to ensure proper reassembly.

10. Next, connect the exhaust and intake components.

ENGINE REMOVAL

For engine removal, follow the engine installation steps in the reverse order. **NOTE:** Be sure to match-mark all hydraulic lines and electrical wiring to ensure proper reassembly.

INDEPTH SERVICE

Refer to the Cummins manuals shipped with the machine for further service and troubnleshooting information.

SYMPTOM	PROBABLE CAUSE	REMEDY
No engine crank	Park brake not engaged	Place park brake switch in "PARK" (ON) position
	Defective fuse	Verify 12 VDC present on pin 1 (blu) on trans. shifter. If absent, replace fuse #7.
	Defective shifter switch	Place jumper between pin 1 (blu) and pin 7 (yel). If engine cranks, replace shifter.
	Defective start enable circuit-defective relay	Place jumper between term #30 (org/grn) and #87 (org/wht). If engine cranks, check park control circuit.
		Place jumper between brn/wht and blk (ground) on park brake switch. If engine cranks, replace park brake switch. If engine does not crank, replace start enable relay #8.
	Transmission not in neutral	Place direction switch in neutral position
	Dead battery	Recharge battery. See BATTERY troubleshooting.
	Defective start control circuit (key switch)	Ensure that switch closes when actuated.
	Defective start magnetic switch.	Ensure that magnetic switch contacts close when 12 VDC is applied to S terminal. If contacts do not close, replace magnetic switch.
	Defective starter motor or solenoid.	Ensure that starter solenoid throws and motor rotates when 12 VDC is applied to solenoid S terminal. Replace solenoid or motor.
	Defective starter motor control wiring.	Inspect wiring for loose, corroded, dirty connector or damaged wiring. Repair or replace wiring.
Starter drive does not engage.	Defective starter.	Repair or replace starter.

SYMPTOM	PROBABLE CAUSE	REMEDY
Engine does not run (Fuel solenoid does not pull in)	Defective fuse	With key ON, verify 12 vdc present between pin A (grn +) and pin C (blk-ground) on the pull coil timer module harness plug. If absent, replace fuse #5.
	Defective circuit breaker	Verify 12 VDC present between pin B (wht +) and pin C (blk-ground) on pull coil timer module harness plug. IF absent, replace circuit breaker, 20A.
	Defective PCTM	Verify 12 VDC present for approx. 1/2 second between pin C (blk +) and pin b (wht -) on fuel control solenoid plug when key placed in "IGN".
		Verify 12 VDC constant between pin C (blk +) and pin A (red -) on fuel control solenoid with key ON.
		If either absent, replace PCTM.
	Defective fuel solenoid-pull in coil	Verify continuity between pin B (wht) and pin C (blk) on fuel control solenoid, If open, replace solenoid.
Engine does not run (Fuel solenoid pulls in but does not hold approx 1/2 second)	Defective PCTM hold-in circuit	Verify 12 VDC constant between pin c (blk +) and pin A (red -) on PCTM fuel control solenoid plug. If absent, replace PCTM.
	Defective fuel control solenoid	Verify resistance continuity between pin C (blk) and pin A (red). If open, replace fuel control solenoid.
Low oil light and pulse alarm do not operate with engine not running	Defective low oil pressure switch	Short low oil pressure switch leads together. If alarms operate, replace switch.
Low oil pressure light and pulse alarm stay on with engine running	Defective low oil pressure switch	Disconnect gry lead on low oil pressure switch. If alarms stop, replace pressure switch.
Low oil pressure light out, pulse alarm on, engine not running	Defective bulb	Replace bulb.

SYMPTOM	PROBABLE CAUSE	REMEDY
Low oil pressure light on, pulse alarm silent, engine not running	Defective sonalert alarm	Replace sonalert alarm.
		NOTE: TO PROTECT THE ENGINE, VERIFY PROPER ENGINE FUNCTION, OIL PRESSURE AND TEMPERATURE BEFORE SUSPECTING A WARNING MALFUNCTION.
Slow cranking and/or solenoid hammering	Low battery charge.	Test battery. See BATTERY troubleshooting.
	Defective starter solenoid. High contact resistance.	Use a 3 VDC scale voltmeter to read voltage drop across starter solenoid B and M posts. Voltage drop should not exceed 0.2VDC. Repair or replace solenoid.
	Excessive cranking circuit resistance.	(positive) Use a 3 VDC scale voltmeter to read positive side voltage drop between battery post (+) and starter solenoid B terminal post. Voltage drop should not exceed 0.4 VDC. Repair or replace dirty, corroded or loose battery cables.
		(negative-ground) Read negative side voltage drop between battery (-) post and starter motor ground terminal post. Voltage drop should not exceed 0.4 VDC. Check all terminals and interfaces.
	Insufficient battery capacity (low cranking voltage)	Use a 30 VDC scale voltmeter to read cranking voltage across starter solenoid B terminal post and starter motor ground terminal post while cranking. Voltage should not drop below 9.5 VDC. Repace battery with one of sufficient capacity or add battery in parallel to increase output capacity.

SYMPTOM	PROBABLE CAUSE	REMEDY
Slow cranking and/or solenoid hammering	Starter solenoid hammering. Hold-in coil open.	Ensure that 9.5 VDC minimum is available to S terminal on starter solenoid. If the starter solenoid hammers with proper voltage applied while cranking, the hold-in coil is open.
	Excessive engine load.	Ensure that engine is free to turn normally. Locate and repair engine defects.

ELECTRICAL SYSTEM

General

This chapter begins with safety information which you should be aware of before working on any component of the electrical system. For your own safety, please observe and practice these precautionary measures.

This chapter consists of troubleshooting charts for electrical system components. It also contains electrical schematics for standard and optional equipment.

Electrical Safety Precautions

Observe the following at all times:

1. NEVER PERFORM MAINTENANCE ON 'LIVE' ELECTRICAL EQUIPMENT. STOP THE ENGINE AND DISCONNECT THE GROUND (-) BATTERY CABLE BEFORE BEGINNING MAINTENANCE.

2. NEVER DISCONNECT THE BATTERY, OR INTERRUPT THE BATTERY CHARGING OUTPUT WIRE FROM THE CHARGING ALTERNATOR WHILE THE ENGINE IS RUNNING. DANGEROUSLY HIGH DIRECT CURRENT VOLTAGES ARE PRODUCED WHICH MAY BE FATAL

3. DO NOT SMOKE OR ALLOW AN OPEN FLAME OR ELECTRIC SPARK NEAR THE BATTERY

4. WHEN REMOVING THE BATTERY, DISCONNECT THE GROUND (-) BATTERY CABLE FIRST. WHEN INSTALLING THE BATTERY, CONNECT THE POSITIVE (+) BATTERY CABLE FIRST. THIS WILL REDUCE THE POSSIBILITY OF TOOL-TO-MACHINE SHORTS.

Battery Maintenance

Every 160 hours of operation or monthly, perform the following battery maintenance:

1. Check the electrolyte level. If level is low, add distilled water to maintain fluid up to level indicator below cell caps. DO NOT OVERFILL CELLS.

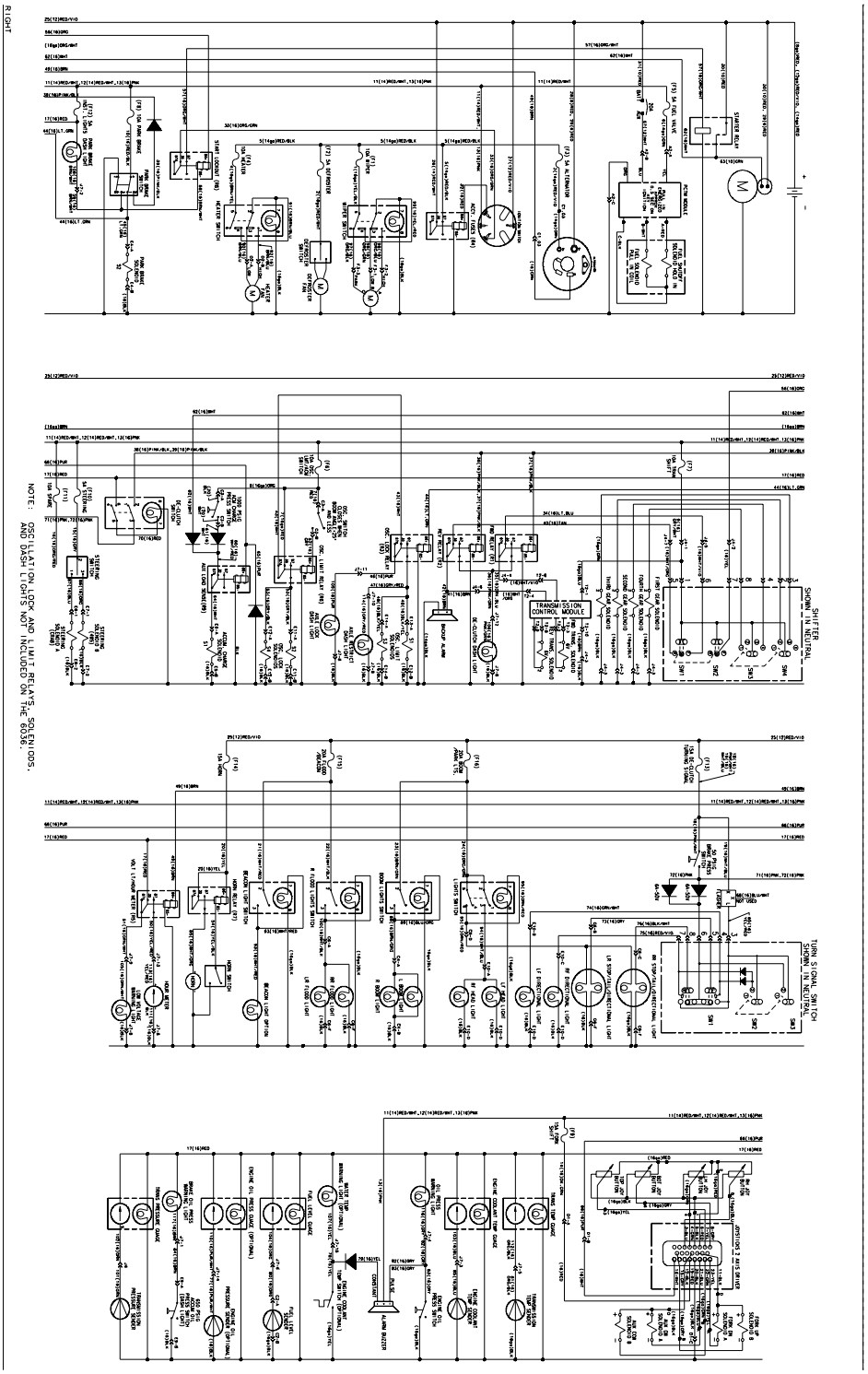
2. Check tightness of battery terminals. Clean corroded terminals with water/baking soda solution. DO NOT ALLOW BAKING SODA SOLUTION TO ENTER THE BATTERY.

3. Inspect battery cables for damage and frayed ends.

If you experience battery failure, check the specific gravity of the electrolyte with a hydrometer. Use a hydrometer with built-in temperature correction, or consult the hydrometer manufacturer's literature for its proper use.

ELECTRICAL SCHEMATIC, FL-11914

FOLDOUT


RIGHT
NOTE: OSCILLATION LOCK AND LIMIT RELAYS, SOLENOIDS, AND DASH LIGHTS NOT INCLUDED ON THE 6000.
TRANSMISSION CONTROL MODULE
SHIFTER SHOWN IN NEUTRAL
TURN SIGNAL SWITCH SHOWN IN NEUTRAL

SYMPTOM	PROBABLE CAUSE	REMEDY
No alternator output	Defective fuse.	Replace fuse #3.
	No power on ACC fuse	See ACCESSORIES Troubleshooting
	Loose of broken belt	Check belt and tighten. replace belt if necessary.
	Defective alternator or voltage regulator.	Replace alternator or voltage regulator.
BATT light does not light, engine not running	Defective bulb.	Replace bulb.
	Defective charge light relay.	Temporarily replace relay #5 with relay #6. If charge light glows, replace relay #5.
BATT light does not go out when alternator charging. Hour meter does not begin counting.	Defective alternator.	Verify XX VDC at alternator W terminal with engine running. If absent, replace alternator.
Hourmeter does not count, BATT light out.	Defective hourmeter.	Verify 12 VDC present to hourmeter T terminal with charge light out. Replace hourmeter.
Low charge rate (alternator output voltage does not rise above 13.2 VDC)	Loose or worn alternator belt.	Tighten or replace belt.
	Excessive alternator loading	Verify that ll engine shut off circuit loads do not exceed 75% of rated alternator capacity.
	Defective alternator or voltage regulator.	Replace alternator or voltage regulator.
	Defective battery.	Test Battery. See BATTERY troubleshooting.
	Excessive charge line resistance, loose, dirty or corroded charge line connectors	Load alternator to rated capacity. Check voltage between alternator output terminal case and battery terminals. Charge voltage at the battery should be within 0.5VDC of charge voltage at the alternator. Inspect and repair or replace defective charge line.

SYMPTOM	PROBABLE CAUSE	REMEDY
High charge rate (output voltage exceeds 15VDC)	Defective alternator or voltage regulator	Replace alternator or voltage regulator.
	Excessive electrolyte temperature.	Electrolyte temperature must not exceed 125° F (51°C) in combination of ambient and charge power dissapation
	Defective battery (internal short).	Test battery. See BATTERY troubleshooting.

BATTERY TROUBLESHOOTING

SYMPTOM	PROBABLE CAUSE	REMEDY
Battery goes dead in a short time (overnight or nonuse week-end)	Electrical accessories on when machine not in use.	Turn accessories off and recharge battery observing proper charging procedure. Test charging circuit for correct operation.
	Defective ignition key switch.	Check that ignition key switch contacts are open when engine is stopped. If contacts are closed, replace switch.
	Defective charging alternator (internal short).	Check that no current is flowing in alternator output line with the engine stopped. If current is flowing, replace alternator.
		NOTE: A VERY SMALL SPARK MAY BE NOTED IF THE OUTPUT WIRE IS DISCONNECTED WHEN THE BATTERY CABLES ARE DISCONNECTED. THIS IS NORMAL.
	Defective battery (shorted internally).	Fully charge battery and disconnect for discharge timer period noted in machine failure. Check charge state at end of test period. Replace battery if it is discharged while disonnected.
	Defective wiring (shorted).	Check all wiring visually, and with meters. Repair or replace defective wiring.

SYMPTOM	PROBABLE CAUSE	REMEDY
Battery at low charge condition.	Loose or worn alternator belt.	Check tension on alternator belt. Tighten or replace belt.
	Defective charging alternator (low voltage)	Check that alternator output voltage maintains 13-14.5 VDC. See CHARGING troubleshooting.
	Excessive charge line resistance (voltage drop)	Check voltage differential between alternator BAT terminal and alternator case, and (+) and (-) battery posts at full alternator current capacity. Maximum allowable differential is 0.5VDC. Check and repair all defective connections.
	Sulphated battery.	Recharge battery to full charge. Check specific gravity of each cell. Temperture corrected readings of each cell should not vary. A variable of more than 0.50 points between cells indicate a bad battery. The chart below indicates battery charge at different hydrometer readings.
	Specific Gravity	Charge
	1.260-1.280 1.230-1.250 1.200-1.220 1.170-1.190 1.140-1.160 1.110-1.130	Full 3/4 Charge 1/2 Charge 1/4 Charge Near dead Dead
		If the battery cannot be recharged or corrected to 1.250 or above, the battery is sulphated. Replace.

SYMPTOM	PROBABLE CAUSE	REMEDY
No power to any gauge, gauge limit lights out or dim	Defective fuse.	Replace fuse #12.
	Defective instrument panel ground.	Verify gauge ground terminal continuity to frame. Repair.
Single gauge does not indicate, gauge light ON.	Defective sender.	Short gauge load to ground at sender. If gauge reads max, replace sender.
	Defective gauge.	If not defective sender (see above) and reading does not change, replace gauge.
Single gauge indicates max.	Defective gauge ground lead (-).	Verify good ground to gauge (-) terminal. Repair.
	Defective sender.	Disconnect sender lead at sender. If gauge drops to minimum, replace sender.
	Defective gauge.	If not defective sender (see above) and reading does not change, replace gauge.
Single gauge indicates incorrectly.	Defective sender or gauge.	Replace sender or gauge.

SYMPTOM	PROBABLE CAUSE	REMEDY
Park brake does not engage.	Defective park brake switch (shorted).	Verify 12 VDC absent on park brake switch lt grn wire when park brake ON. If present, replace switch.
Park brake does not release.	Defective park brake switch (open).	Verify 12 VDC present on park brake solenoid plug pin A (lt grn +) to pin B (blk -) with park brake OFF. If not present, replace switch.
	Defective solenoid coil.	Verify coil resistance 9.2 ohms. If open or high, replace coil or solenoid assembly.
	Defective solenoid.	If electrical check ok, replace solenoid.
Park brake light does not illuminate in PARK.	Defective bulb or lamp assembly.	Replace bulb or assembly.
	Defective park brake switch.	Place jumper between brn/why and blk (ground) on park brake switch. If lamp lights, replace switch.

CLUTCH CUT-OFF NOTE:
CLUTCH CUT-OFF IS OPERATIONAL ONLY WHEN TRANSMISSION IS ENGAGED IN FWD OR REV.

SYMPTOM	PROBABLE CAUSE	REMEDY
No FWD or no REV CCO light OFF	Defective CCO relay.	Jump relay #30 to #87A of affected direction. If transmission engages, replace relay #1 for FWD or relay #2 for REV.
No FWD and REV, foot brake released, CCO arm switch OFF	Park brake switch in PARK (CCO light ON, park brake light ON).	Release park brake (switch to OFF).
	Defective park CCO control circuit, CCO arm switch OFF.	Verify 12 VDC absent on park brake switch pnk/blk wires when park brake OFF. If present, unplug switch. If voltage now absent, replace park brake switch.
No FWD and REV, foot brake applied, CCO arm switch ON	Foot brake applied with CCO arm switch ON (arm switch light ON, CCO light ON).	Release foot brake or turn CCO arm switch OFF.
No FWD and REV, foot brake released, CCO arm switch ON.	Defective brake light switch.	Unplug pnk wire on brake light switch. If FWD and REV engages, replace brake light switch.
Transmission does not disengage when foot brake applied, CCO light does not light, arm switch ON.	Defective brake light fuse.	Verify 12 VDC present on pnk/wht wire. If absent, replace fuse #13.
	Defective brake light switch.	Verify 12 VDC present on CCO arm switch pnk wire when foot brake applied. If absent, replace brake light switch.
	Defective CCO arm switch.	Verify 12 VDC present on pnk/blk wire on CCO switch when foot brake applied with CCO switch ON. If absent, replace CCO switch.
	FWD or REV only. Defective CCO relay.	Switch FWD and REV relays. If direction of disengagement reverses, replace defective relay.
Transmission does not disengage when park brake applied.	Defective isolation diode (open) in park brake switch lead (pnk/blk).	Verify 12 VDC present on CCO arm switch pnk/blk when park brake applied, CCO switch OFF. If absent, replace diode.
	Defective park brake switch.	Verify 12 VDC present on park brake switch pnk/blk wire with park brake applied. If absent, replace park brake switch.

SYMPTOM	PROBABLE CAUSE	REMEDY
Backup alarm does not sound in REV, transmission works properly	Defective backup alarm.	Verify 12 VDC present between backup alarm + (brn) and - (blk) when REV, CCO arm switch Off, park brake OFF. If present, replace backup alarm.
Horn does not sound.	Defective fuse.	Replace fuse #14.
	Defective relay control circuit (steering column pickup assy, wiper ring, horn button).	Remove horn button. Short button lead to ground. If horn sounds, clean or replace horn button.
		Remove column pickup assy cover and short yel/blk wire to ground. If horn sounds, repair or replace pickup assy, column wiper ring and uplead.
	Defective horn relay.	Temporarily replace relay #7 with relay #8. If horn sounds, replace relay #7.
	Defective horn.	Verify 12 VDC present to horn wire (wht/org) when button depressed. If present, replace horn.
Horn sounds continuously	Defective relay control circuit, steering column pickup assy, wiper ring, or horn button.	Remove horn button. If horn stops, repair or replace horn button. Remove column pickup assy cover. Disconnect wire (yel/blk). If horn stops, repair or replace pickup assy, wiper ring and uplead.
	Defective horn relay.	Temporarily replace relay #7 with relay #8. If horn works properly, replace relay #7.

HEAD AND TAIL LIGHT TROUBLESHOOTING

SYMPTOM	PROBABLE CAUSE	REMEDY
No head or tail lights	Defective fuse.	Verify 12 VDC present at headlight switch (org/grn wire). If absent, replace fuse #16.
1 light out (head or tail).	Defective bulb.	Verify 12 VDC present to lamp assy. If present, replace bulb.
Headlights ON, taillights OUT.	Defective headlight switch.	Verify 12 VDC present on org/red wire of headlight switch with switch ON. If absent, replace switch.
Tailights ON, headlights OUT.	Defective switch.	Verify 12 VDC present on wht/blu wire of headlight switch with switch ON. If absent, replace switch.
Indicator bulb in switch out.	Defective switch.	Replace switch.
		NOTE; HEADLAMP ASSYS USE QUARTZ/HALOGEN TYPE H3 BULBS. USE CARE NOT TO TOUCH QUARTZ ENVELOPE, TO PREVENT EARLY BURN-OUT.

REAR FLOODLIGHT TROUBLESHOOTING

SYMPTOM	PROBABLE CAUSE	REMEDY
No rear floodlights.	Defective fuse.	Verify 12 VDC present on wht/blk center wire of rear flood light switch.. If absent, replace fuse #15.
.	Defective bulb.	Verify 12 VDC present to lamp assy. plug. If present, replace bulb.
	Defective switch.	Verify 12 VDC present on wht/blk end wire of rear floodlight switch with switch ON. If absent, replace switch.
		NOTE: FLOODLAMP ASSYS USE QUARTZ/HALOGEN TYPE H3 BULBS. USE CARE NOT TO TOUCH QUARTZ ENVELOPE, TO PREVENT EARLY BURN-OUT.

BRAKE (STOP) LIGHT TROUBLESHOOTING

SYMPTOM	PROBABLE CAUSE	REMEDY
No brake lights (CCO foot operation does not work).	Defective fuse.	Verify 12 VDC present tp pnk/wht wire at brake light switch. If absent, replace fuse #13.
	Defective brake light switch.	place jumper across brake light switch terminals. If brake lights light, replace brake light switch.
No brake lights (CCO foot operation normal) w/o directional lights option	Defective isolation diodes in directional lever (optional) harness.	Verify 12 VDC present on pin 6 (pnk) of directional lever plug jumper. If absent, replace diodes.
No brake lights (CCO foot operation normal with directional lights option).	Defective directional lever assy.	Unplug directional lever. Jump pins 6 (pnk), 5 (gry), & 8 (blk/wht) together on harness plug. If brake lights operate, replace directional lever assy.
1 light OUT.	Defective bulb.	Verify 12 VDC presenton red leadof brake/Tail lamp assy. If present, replace bulb.

SYMPTOM	PROBABLE CAUSE	REMEDY
No directional lights, no brake lights, no hazard lights	Defective fuse.	Verify 12 VDC present to wht/blu lead of flasher plug. If absent, replace fuse #13.
Directional lights do not light. Brake lights normal.	Defective flasher.	Remove flasher and jump wht/blu lead to yel/red lead in flasher socket. If directionals light but do not flash, replace flasher.
	Defective directional lever assy.	Verify 12 VDC available to pin 3 (yel/red) of directional lever plug. If present, replace directional lever assy. NOTE: VOLTAGE MAY PULSE AT SIGNAL RATE.
Directional lights light but do not flash.	Defective flasher.	Replace flasher.
1 light OUT.	Defective bulb.	Replace bulb.
	Defective directional lever.	Unplug directional lever and jump harness plug as follows for affected lamp: pin 3 (yel/red) to pin 4 (grn/wht) LF pin 3 (yel/red) to pin 7 (red/blu) RF pin 3 (yel/red) to pin 5 (gry) LR pin 3 (yel/red) to pin 8 (blk/wht) RR If affected lamp lights, replace directional lever assy.
Hazard lights will not engage.	Defective directional lever assy.	Replace lever assy.
Hazard lights will not disengage.	Defective directional lever assy.	Replace lever assy.

SYMPTOM	PROBABLE CAUSE	REMEDY
No power on, ACC fuses with key in ACC or IGN	Defective key switch.	Verify 12 VDC present on ACC ICCY terminal in IGN and ACC positions. If one or both absent, replace key switch.
	Defective ACC power relay.	Temporarily replace relay #4 with relay #7. If ACC fueses now powered, replace relay #4.
Wiper does not operate in any mode.	Defective fuse.	Verify 12 VDC present on wiper switch (yel/blk) wire. If absent, replace fuse #1.
Wiper runs on HIGH only. Parks randomly in low or OFF.	Defective wiper motor.	Replace motor.
Wiper runs in low only, parks normally.	Defective wiper switch.	Verify 12 VDC present to wiper motor red lead in high. If absent, replace switch.
	Defective wiper motor.	If 12 VDC present when testing wiper switch, replace motor.
Wiper park is random with switch OFF, low and high normal.	Defective switch.	Unplug wiper motor. Verify 12 VDC present on plug blk wire with switch in park. If absent, replace switch.
	Defective motor.	If 12 VDC present when testing switch, replace motor.
Wiper runs continuously in park.	Defective switch.	Unplug wiper motor, verify 12 VDC present on blk wire only when switch in park. If present on grn or blu wires, replace switch.
	Defective motor.	If switch tests ok, replace motor.
Heater does not run, either position.	Defective fuse.	Verify 12 VDC present at heater switch brn/yel wire. If absent , replace fuse #4.
Heater runs low speed only.	Defective switch.	Verify 12 VDC present on heater plug brn/blu pin A in LO position. If absent, replace switch.
	Defective motor.	If switch tests ok, replace motor

SYMPTOM	PROBABLE CAUSE	REMEDY
Heater runs HI speed only.	Defective switch.	Verify 12 VDC present on heater plug brn/org pin B in HI position. If absent, replace switch.
	Defective motor.	If switch tests ok, replace motor.
Defroster fan does not run either HI or LO	Defective fuse.	Verify 12 VDC present to switch in fan base. If absent, replace fuse #2.
	Defective switch.	Verify 12 VDC present to both HI and LO switch terminal when switch actuated. If absent, replace switch or fan assy.
Defroster fan does not run in LO.	Defective switch.	Verify 12 VDC present on LO speed terminal of switch when actuated. If absent, replace switch or fan assy.
	Defective fan assy motor.	If switch tests ok, replace fan assy.
Defroster fan does not run in HI.	Defective switch.	Verify 12 VDC present on HI speed terminal of switch when actuated. If absent, replace switch or fan assy.
	Defective fan assy motor.	If switch tests ok, replace fan assy.

NOTES

BOOMS

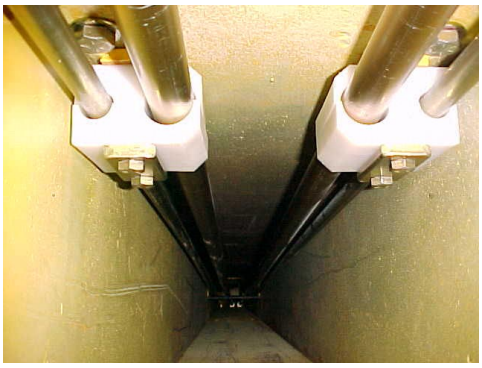
ASSEMBLY

1. Install bottom and one side wear pad into rear of boom 1.

2. Install tubes into boom and attach fittings onto tubes in the front of boom 1. NOTE: The outside tubes for the tilt cylinder have 10/10 fittings and the inside tubes for the extra circuit use 10/8 fittings.

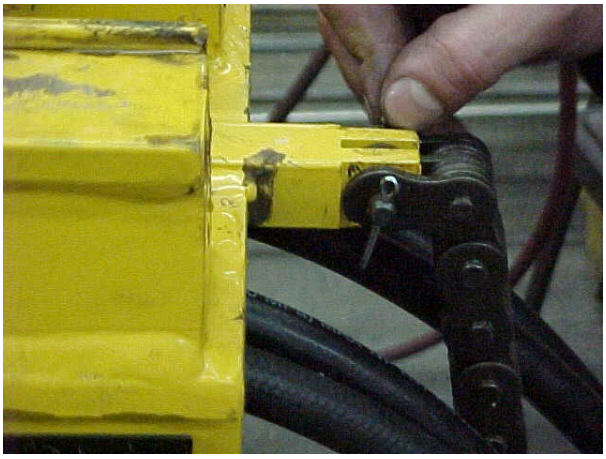
3. Use a pry bar to raise the tubes in the middle to ease in installation.

4. Install clamps and hoses onto the tip end of tubes and then clamp and attach the tubes to the other end of the boom.



5. Install middle clamps through the access hole in each side

6. Install retract chain onto top of boom 1 and set into place with pin and cotter. On rear of boom 1 attach extension chain and set into place with pin and cotter.



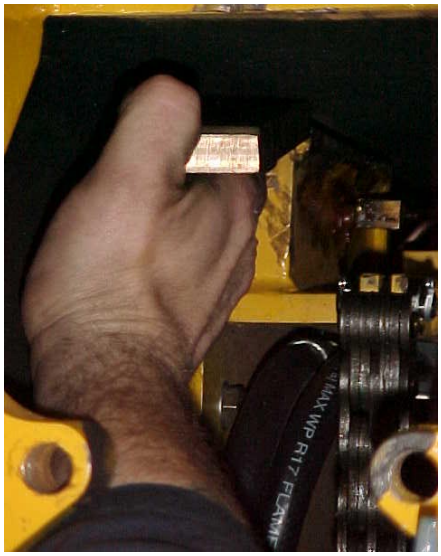
7. Install grease lines onto top of boom 1 and tuck hoses and extension chain into boom for easier assembly into boom 2.

8. Attach hoist to boom 1 and guide into boom 2.

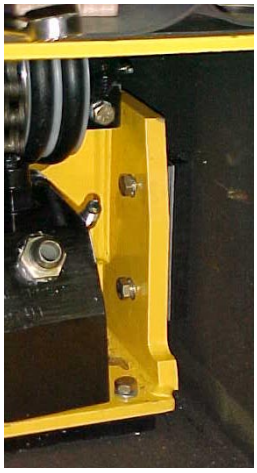
9. Install 2nd rear side wear pad onto boom 1 once installed into boom 2.

10. Install front bottom wearpad onto boom 2 after boom 1 is partially inserted into boom 2.

11. Install top rear wearpad after boom 1 is installed into boom 2.



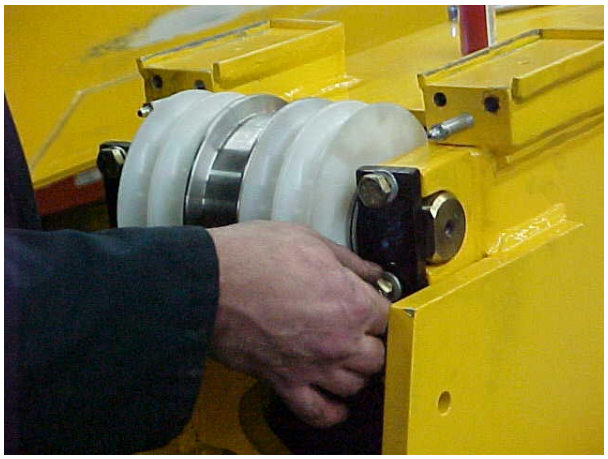
12. Install top rear wearpad bracket.
13. Install side wearpad onto boom 2.

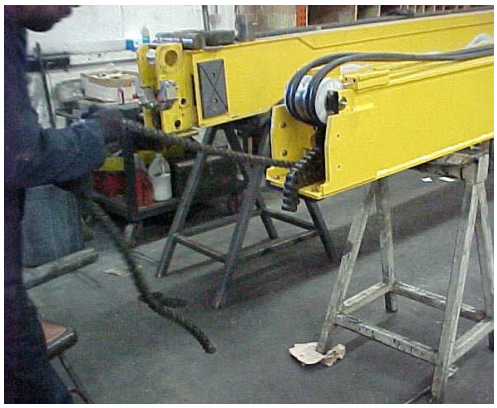


14. Install top spacer block on the front of boom 2 (between boom 2 & 1).

15. Install chain roller and roller bolts onto top of boom 2.

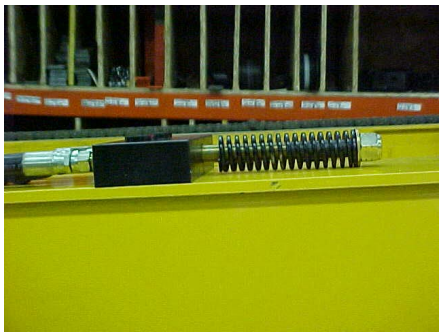
16. Install hose sheaves onto back of boom 2, and pull hoses and chain out of boom 1.





17. Attach hoses to boom manifold on top of boom 2.

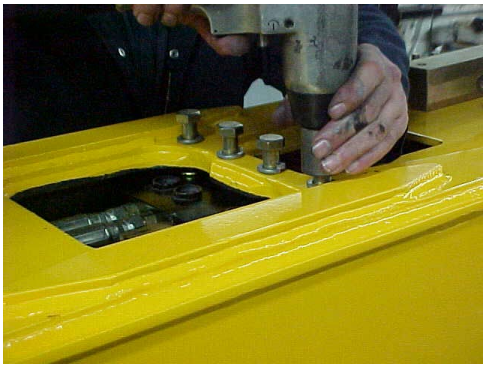
18. Attach chain anchor and insert through manifold and attach spring and nut. NOTE: Chain anchor must have anti-seize applied.

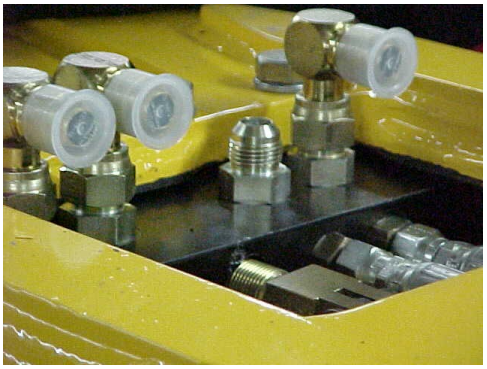


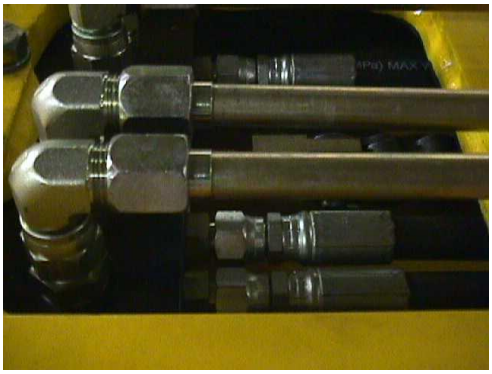
19. Lift extension cylinder with proper hoist and insert into boom 2. Install 4 bolts on back of extension cylinder into rear of boom 2. Also install the fittings onto the extension cylinder.

20. Using the proper hoist, lift boom1 & 2 into boom 3.

21. Install washers and bolts through boom 3 into manifold on top of boom 2. Next install fittings onto manifold and connect the tubes to the fittings.

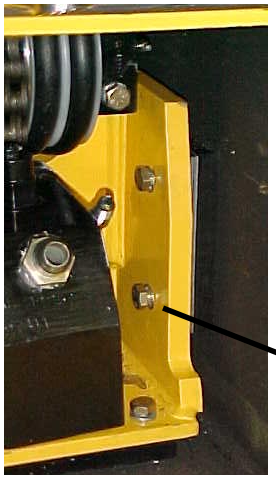


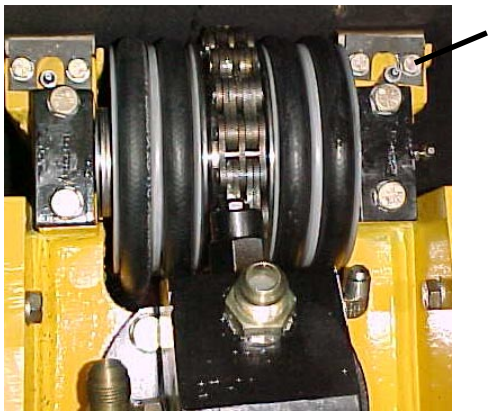




22. Install side wear pads into front of boom 3 and install spacer onto top.

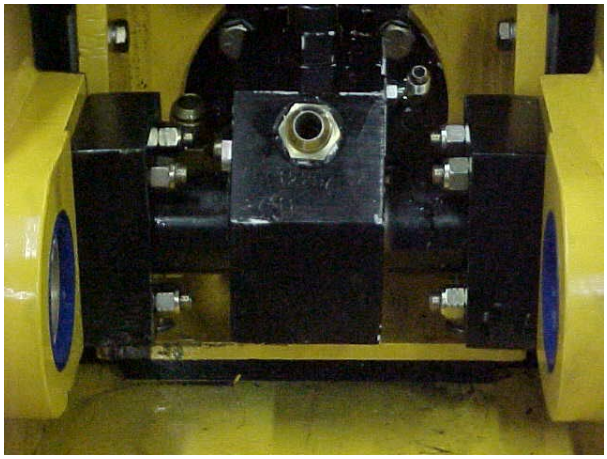
23. Install back side wear pad into boom 2 and top wear pads into boom 3.

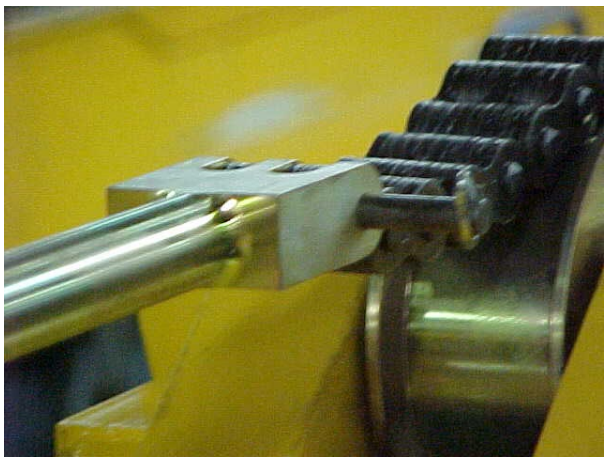




24. Use a come-along on top of boom3 and attached to boom 1to pull booms together so chain and extension cylinder can be attached into back of boom 3.

25. Attach trunnion blocks to extension cylinder and attach blocks to boom 3. Attach chain to anchor.





26. Insert set screws and bushings into boom 3 and attach hoses and bulkhead fittings into back of boom 3.

BOOM DISASSEMBLY

1. Reverse order to disassemble.

BOOM INSTALLATION/REMOVAL

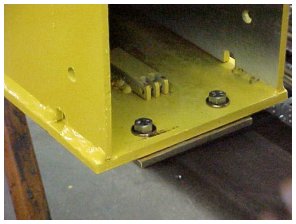
1. Attach boom onto machine using the proper hoists. See 8,000 Pound Boom Installation procedure.

8,000 POUND & 10,000 POUND-44' BOOM

Boom Assembly

1. Install the grease fitting and grease line to the boom tip.

2. Install the bottom, side and top wear pads.



3. Insert boom tubes into the boom tip. Larger diameter boom tubes are both on the inside and the smaller diameter tubes are both on the outer sides.

4. Use a pry bar to raise the tubes in the middle to ease in installation.

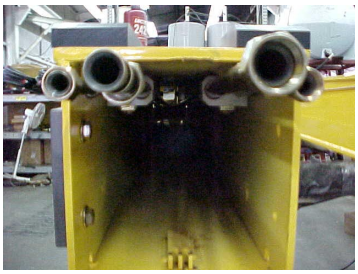
5. Attach fittings to all boom tubes at the tip. Also install small hoses to small tubes and install into tip.

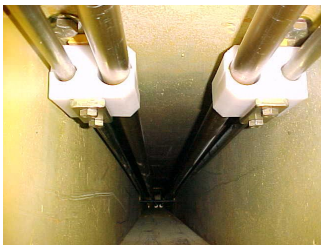
NOTE: LARGER HOSES WILL BE ADDED LATER.

6. Install clamp onto tubes on tip end of boom.

NOTE: USE LOCKTIGHT ON BOLT TO FASTEN ALL CLAMPS TOGETHER.

7. Install clamps and hoses onto other end of tubes and then attach the tubes to the boom.

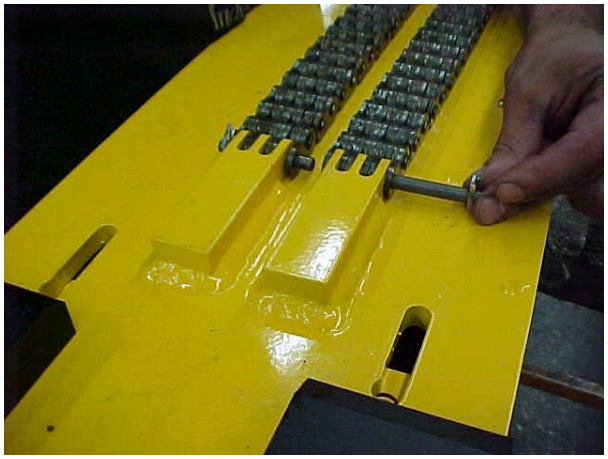




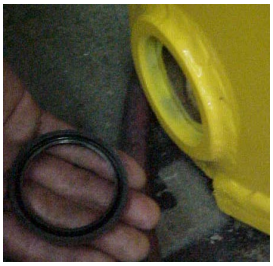
8. Install middle clamps through the access hole in each side

9. Install large hoses to boom tip tubes.

10. Attach front end of each extend chain with the pin and cotter pin.



11. Install seal into quick disconnect tip



12. Install bracket on tip and tighten side tilt hydraulics if equipped.

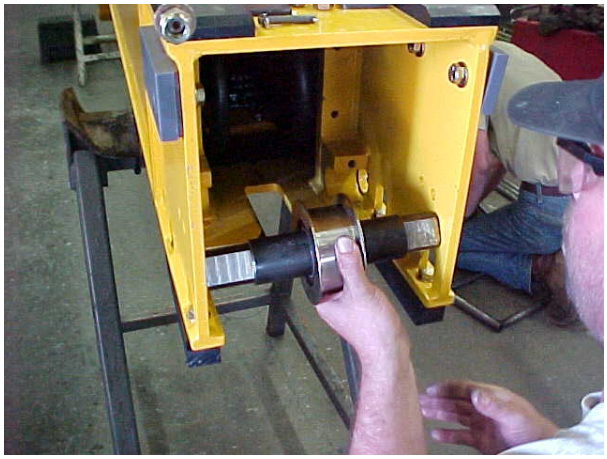
13. Attach one end of retract chain and tuck chain and hoses into boom tip.

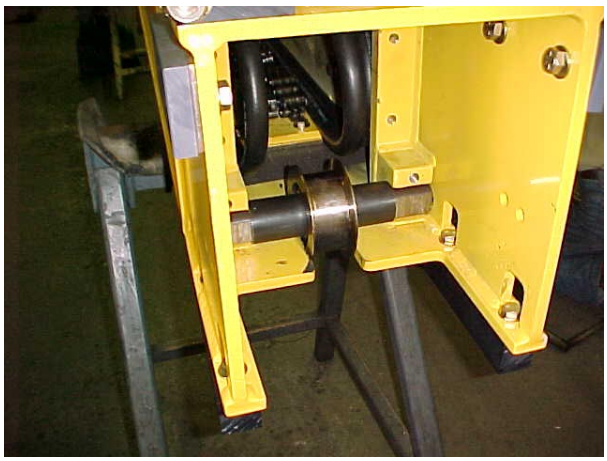
14. Lift tip with hoist and guide into middle section of boom.

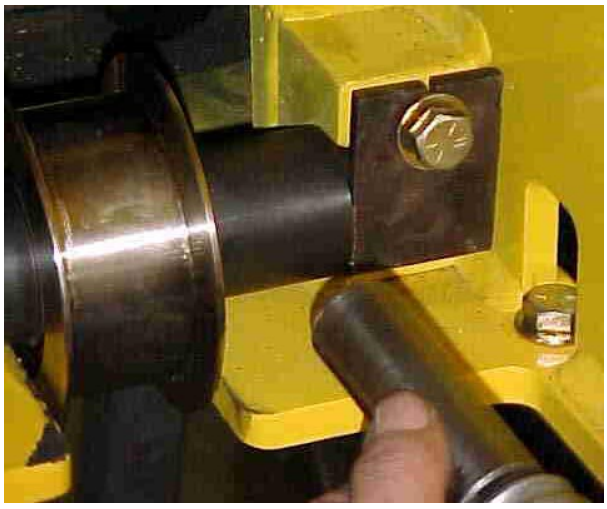
15. Install bottom wear pad and keeper.

16. Install side and top wear pads. Tighten all wear pads into place.

17. Install retract chain roller into place on back end of the middle boom and attach with brackets and locktighted bolts.



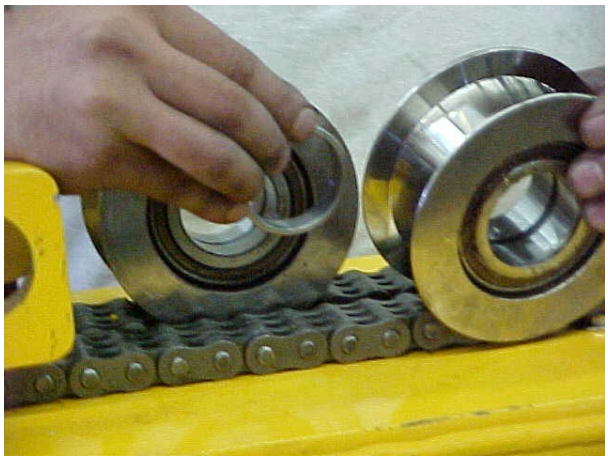


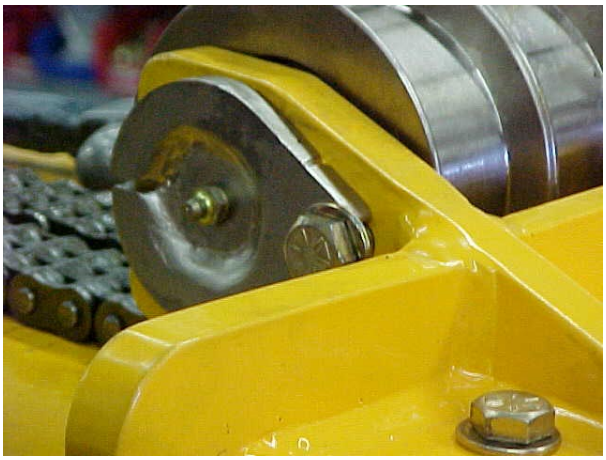


18. Insert pin and cotter pin onto retract chain.

19. Attach extend chain rollers with shim to top of boom.

NOTE: THERE IS A GREASE FITTING ON EACH SIDE OF THE ROLLERS. MAKE SURE TO GREASE BOTH.

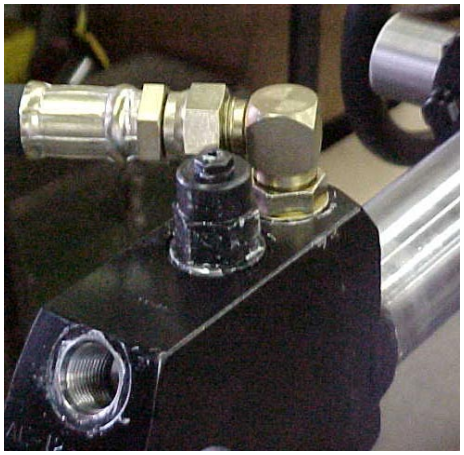


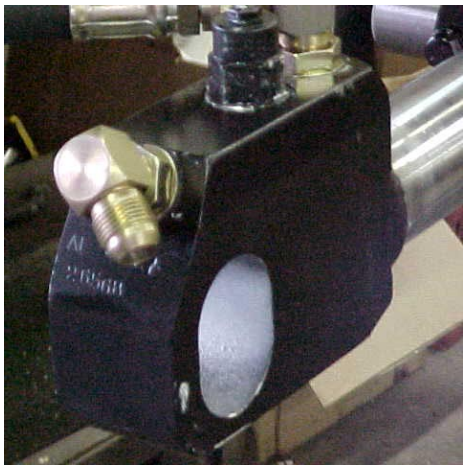


20. Install the extend cylinder grease fitting and move hoses and chain to ease in installation.

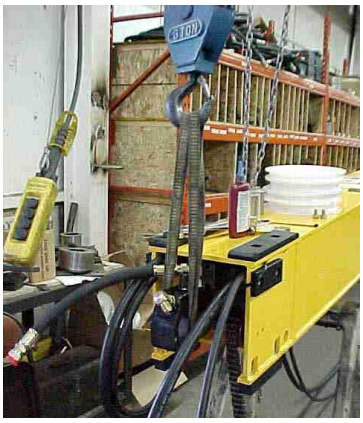
21. Lift the extend cylinder using the proper hoist and insert it into the boom. Set down and readjust hoist as necessary.

22. Before the cylinder is completely into the boom, place a drain pan underneath counterblance valve, remove plugs and install fittings. Temporarily restrain hose on valve with plastic tie to ease in installation.



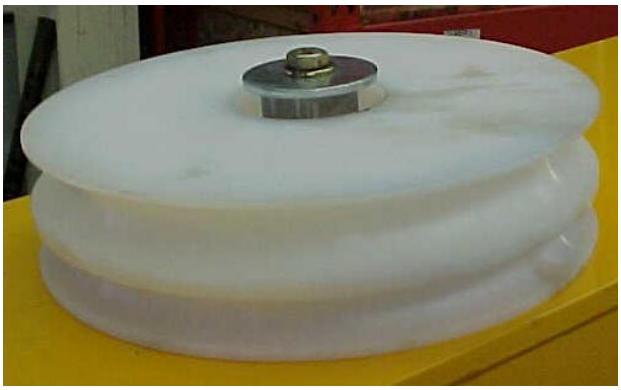


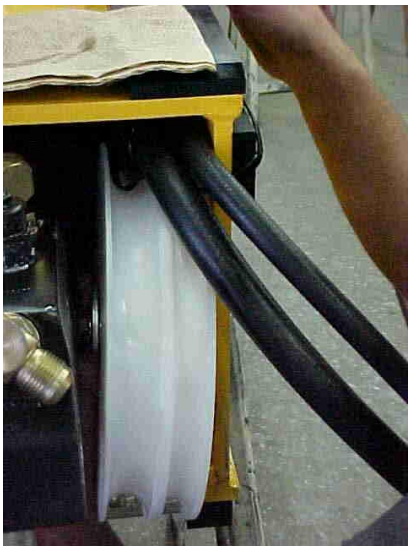
23. Attach trunnion blocks to boom with bolts and locktight.



24. The extend cyinder is fully into the boom at this point. Before installing the pin, shine a light through the tip end of the boom to check alignment of the cylinder. Install pin through extend cylinder and attach with locktight and bolt. Attach boom length decal to midddle boom.

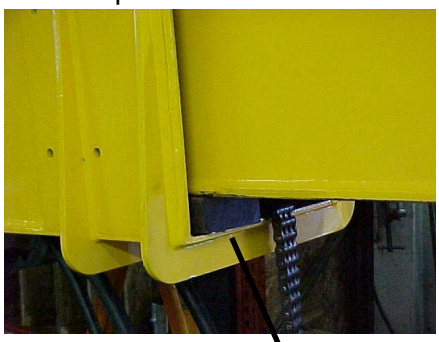
25. Next install sheave assembly and tighten.





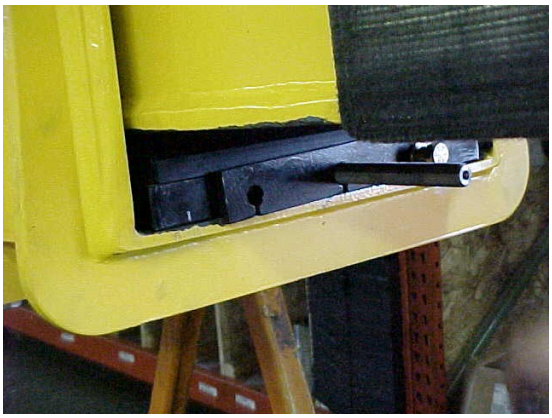
26. Now you're ready to install the mid/tip boom into the main section of the boom. Attach a hoist to the mid/tip section of the boom and feed the hoses through the opening in the main boom as you collapse the boom sections together.

27. Temporarily install a block into the main boomto prevent damaging retract chain and readjust your hoist and continue to collapse the boom sections.



28. Install the hoses onto the boom manifold, tighten and install manifold onto underside of main boom.

29. Install retract chain bolt through retract chain plate and bottom wear pad onto main section of the boom.



30. Attach extend chains to boom.

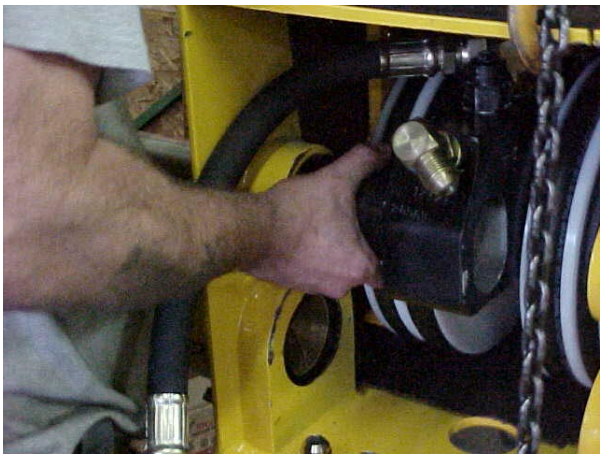
NOTE: APPLY ANTISEIZE TO ALL CHAIN ANCHOR BOLTS

31. Install the top and side wear pads and shims to the main section of the boom.

NOTE: WE TAPE THE SHIMS TO THE WEAR PADS WITH ELECTRICAL TAPE SO WEAR PADS/SHIMS STAY TOGETHER DURING INSTALLATION.

32. Attach a come-along to tip end of boom and end of main boom with a spacer temporarlily inserted between the tip and middle boom and collapse boom sections together.

33. Install extend cylinder pin through main boom through valve and attach with pin and bolt.



34. Cut plastic tie on counterbalnce hose and attach to bulkhead fittings on boom.

NOTE: FIXED MACHINES USE STRAIGHT FITTINGS AND T-MACHINESUSE 90° FITTINGS.

T-MACHINE BULKHEAD FITTINGS

FIXED MACHINE BULKHEAD FITTINGS

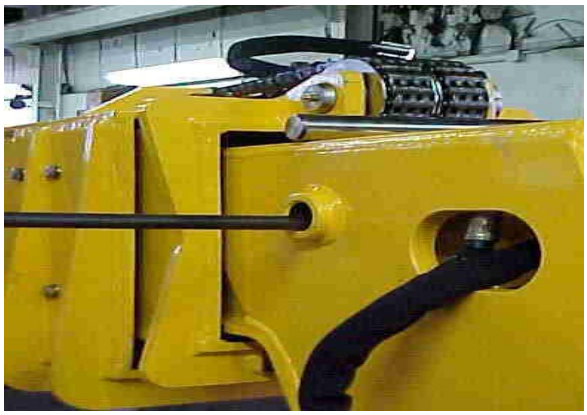
BOOM DISASSEMBLY

Follow the procedure in the reverse order for disassembly.

Fork Tilt Cylinder Installation

1. Lift the cylinder with a hoist, being careful not to damage the hydraulic j-tube and hoses.

2. Align the cylinder using a pry bar on one side as you install the pin on the other.



3. Tap the pin through the frame and mounts on the boom.

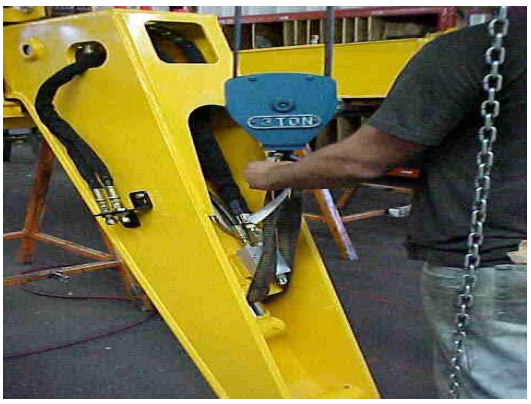
4. Install the bolt through the frame and into the pin and fasten with the nylock nut.

5. Connect the hose to the j-tube on the cylinder

6. Tighten the hoseto the j-tube.

7. Next connect the hose to the counterbalance valve and tighten.

8. Readjust the hoist so you can slide the hose clamp around the cylinder.



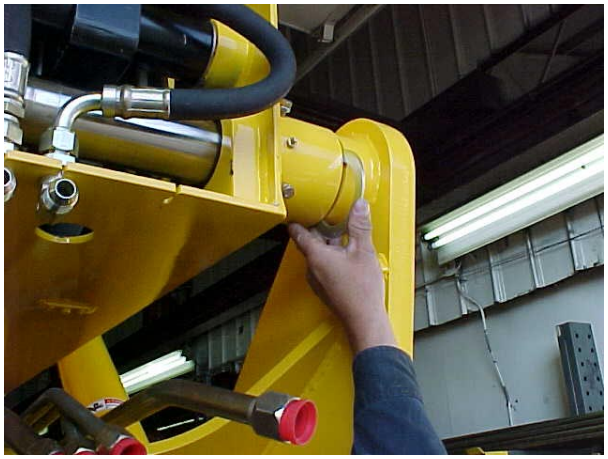
9. Tighten the clamp around the cylinder and hoses.

FORK TILT CYLINDER TROUBLESHOOTING

SYMPTOM	PROBABLE CAUSE	REMEDY
Cylinder will not operate when rocker switch is actuated	Failed hose or hose connections.	Replace hose or tighten loose connections.
	Low oil level in reservoir.	Add oil to 'FULL' mark on reservoir gauge.
	Oil bypassing spool in main valve.	Replace defective spool seal(s).
	Rod wiper leaking excessively.	Replace defective wiper.
	Oil bypassing cylinder piston.	Replace defective piston seal.
	Faulty pump operation.	Repair or replace pump.
	Load larger than capacity.	Reduce to rated load capacity at rated load center.
Cylinder drifts (will not remain in position)	Oil bypassing cylinder piston.	Replace defective piston seal.
	Oil bypassing counterbalance valve cartridge.	Replace defective cartridge seal(s).
	Oil bypassing spool in main valve.	Replace defective spool seal (s).
	Spool not centering in main valve.	Replace spool centering springs.

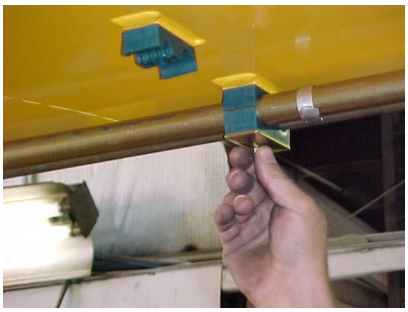
BOOM INSTALLATION

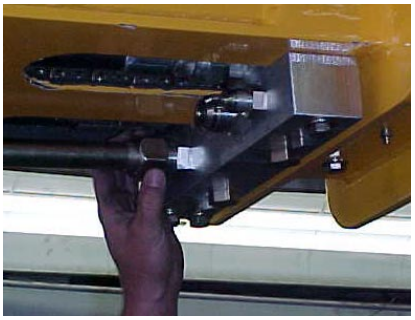
1. Lift completed boom with hoist and guide between lift cylinders to back of frame. Install shaft with shims and torque bolt to proper specifications.



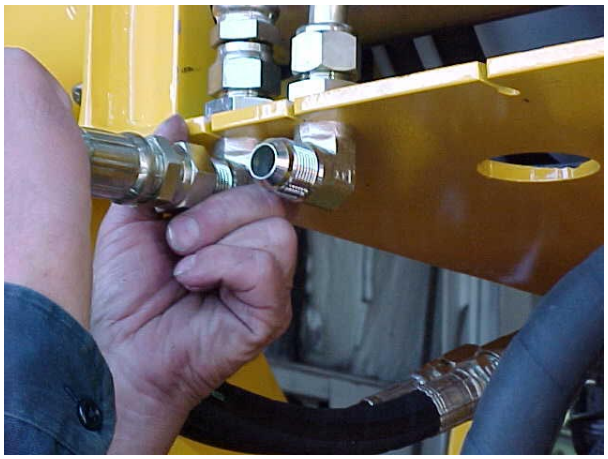
2. Start machine up and extend lift cylinder between mounts on shaft. Turn machine off. Apply antiseize to lift cylinder pin, install shim (s) between frame and cylinder and install pin. Fasten pin with locktight on bolt and torque to 80 foot/ pounds. Follow the same procedure on other side of boom.

3. Install clamps and tubes onto underside of boom and attach tubes to boom manifold.





4. Install hoses onto tubes and attach hoses to bukhead fittings andtighten.



5. Lift quick disconnect with hoist and align with boom tip. Install pin and shim and bolt into place with locktight. Torque to proper specifications.

6. Assemble pin assembly together and install into quick disconnect. Attach other weldments and plates to quick disconnect and disconnect from hoist.

7. Align frame tilt cylinder into quick disconnect and fasten with pin and bolt with locktight.

BOOM REMOVAL

Follow the procedure in the reverse order to remove the boom from the machine.

NOTES

10,000 POUND-56' FIXED BOOM

DISASSEMBLY

The fork frame, quick disconnect and tilt cylinder can be removed from the boom without the boom being removed from the machine.

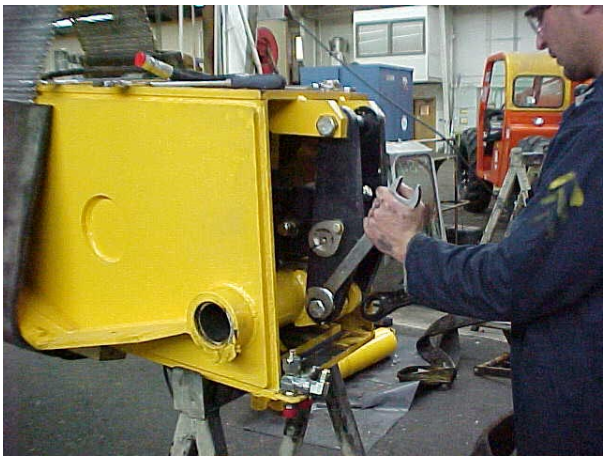
1. Remove forkframe, lower tilt cylinder pin, quick disconnect pin and with a hoist lift the quick disconnect from boom 4. NOTE: Place a bar into the cylinder hole where the pin used to connect to ease in tilt cylinder removal.

2. Remove plate from front of boom 4.

3. Remove hoses from valve and pin from the top of the tilt cylinder. Using a hoist remove the tilt cylinder from the machine and place onto a pallet or blocks.

COMPLETE DISASSEMBLY

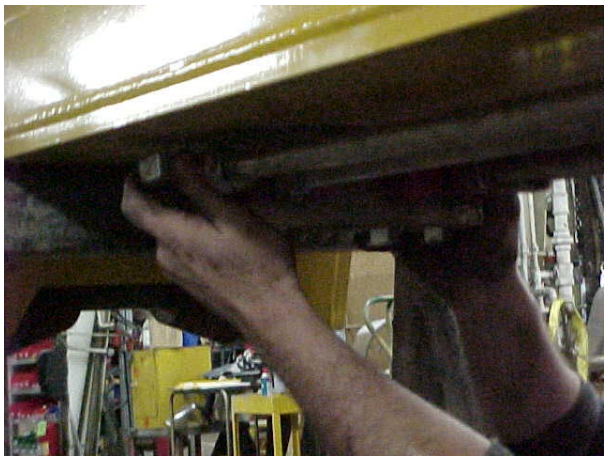
1. With the boom on appropriate stands, remove bulkhead fittings and hoses and extension cylinder bracket from back of boom.



2. Remove chain anchors from top of boom.

3. Remove side wear pads from boom 1 near the front of the boom.

4. Remove tubes from boom manifold and then remove manifold from underside of boom and cap manifold fittings. Do not remove hoses at this time. Pull hoses and chain from boom 1 as boom is being pulled apart.



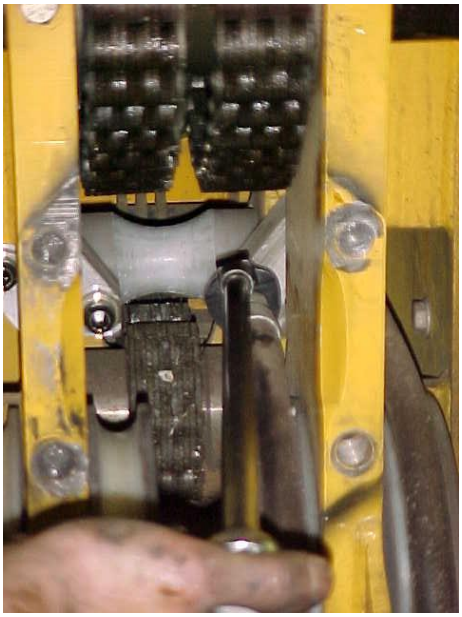
5. Remove bolt from boom 1 bottom roller. With boom still connected, attach hoist to boom 2 and start pulling boom 2 from boom 1. Once boom 2 is partly removed from boom 1, remove pin and bottom rollers from boom 1.

6. If necessary, use a wood blockother means against back of exrtension cylinder to help push boom 2 from boom 1.

7. Once boom 2 is almost out of boom 1, attach another hoist to boom 4 and adjust boom 2 hoist to help balance boom 2 once it is completely removed from boom 1. Place boom on appropriate stands.

8. Remove top rollers from back of boom 2, then remove 4 bolts from extension cylinder and manually pull from boom 2. Attach hoist at midpoint of extension cylinder and remove completely from boom 2.

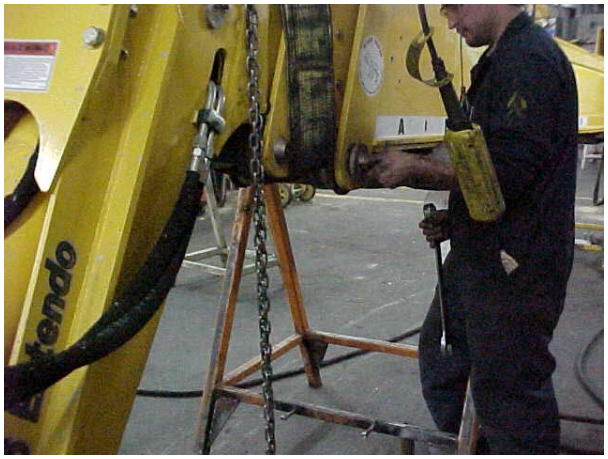
9. Remove hoses from manifold on rear of boom 2 and cap fittings to prevent contamination.



10. Remove hose sheaves

11. Remove side and top wear pads near the front of boom 2, then remove the chain sheave pins.

12. Remove bottom roller pin bolt and then start pulling boom 3 from boom 2. Once boom 3 is partially removed, remove the complete bottom roller assembly from boom 2. Place boom on appropriate stands.



13. Remove top rollers from back of boom 3.

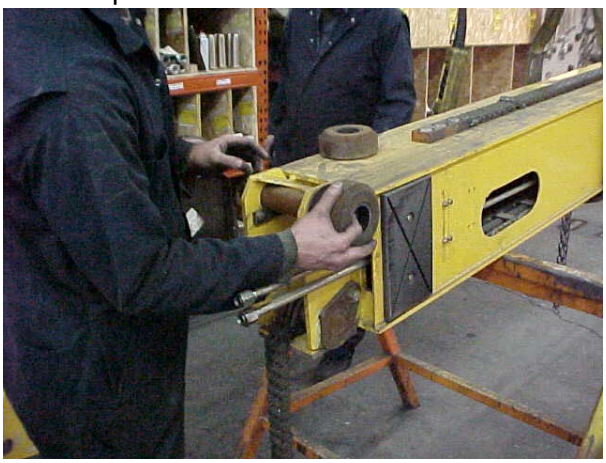
14. Place a drain pan underneath back of boom 3 and remove tubes from manifold. Cap manifold fittings and tubes to prevent contamination.

15. Remove screw, pin and pin roller.

16. Remove side and top wear pads and top roller from boom 3.

17. Attach a hoist to boom 4 and remove from boom 3. Place boom onto tip and appropriate stand.

18. Remove top rollers amd roller pin bracket and pin.



19. Remove clamps from bottom of boom 4 and bolts from top mount inside the tip to remove the gore-trak. Pull the gore-trak assembly out through the tip of boom 4.

NOTE: Bottom wear pads should be installed before assembling booms together and removed after booms are separated.

BOOM ASSEMBLY

1. Reverse order for assembly.

BOOM REMOVAL/INSTALLATION

Use the 8,000 pound boom instructions for removal and installation.

BOLT TORQUE VALUES

Size	SAE Grade	Dry	Lube
1/4 - 20	5	8 Ft. Lbs.	75 In. Lbs.
1/4 - 28	5	10 Ft. Lbs.	86 In. Lbs.
5/16 - 18	5	17 Ft. Lbs.	13 Ft. Lbs.
5/16 - 24	5	19 Ft. Lbs.	14 Ft. Lbs.
3/8 - 16	5	30 Ft. Lbs.	23 Ft. Lbs.
3/8 - 24	5	35 Ft. Lbs.	25 Ft. Lbs.
7/16 - 14	5	50 Ft. Lbs.	35 Ft. Lbs.
7/16 - 20	5	55 Ft. Lbs.	40 Ft. Lbs.
1/2 - 13	5	75 Ft. Lbs.	55 Ft. Lbs.
1/2 - 20	5	90 Ft. Lbs.	65 Ft. Lbs.
5/8 - 11	5	150 Ft. Lbs.	110 Ft. Lbs.
5/8 - 18	5	180 Ft. Lbs.	130 Ft. Lbs.
3/4 - 10	5	260 Ft. Lbs.	200 Ft. Lbs.
3/4 - 16	5	300 Ft. Lbs.	220 Ft. Lbs.
7/8 - 9	5	400 Ft. Lbs.	300 Ft. Lbs.
7/8 - 9	Ferry Bearing Bolts	808 Ft. Lbs.	606 Ft. Lbs.
7/8 - 14	5	440 Ft. Lbs.	320 Ft. Lbs.
1 - 8	5	580 Ft. Lbs.	440 Ft. Lbs.
1 - 8	Ferry Bearing Bolts	1212 Ft. Lbs.	909 Ft. Lbs.
1 - 12	5	640 Ft. Lbs.	480 Ft. Lbs.
1-1/8 - 7	Ferry Bearing Bolts	1702 Ft. Lbs.	1276 Ft. Lbs.
1-1/4 - 7	5	1120 Ft. Lbs.	840 Ft. Lbs.
1-1/4 - 7	Ferry Bearing Bolts	2162 Ft. Lbs.	1621 Ft. Lbs.